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Final Report

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**National Highway
Traffic Safety
Administration**

Evaluation of Passive Belts for Different Size Occupants

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16. Abstract

This report presents results from fifteen additional sled tests of the Volkswagen passive belt restraint system with Part 572 50th percentile male dummies in 90° lateral, 30° oblique and frontal impacts. The main objective of these tests was to examine how the performance of the restraint was affected by different orientations of the belt within the comfort zone. The test data exhibit a trend of improved performance as the belt is positioned higher and at a steeper angle across the torso in that the tendency to roll over the belt is reduced. It is concluded that the proposed belt fit compliance test procedures do not yield repeatable and realistic results for the belt position and hence are unsatisfactory for the intended purpose.

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METRIC CONVERSION FACTORS

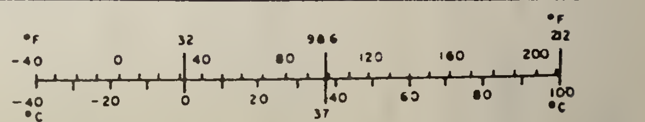
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This report contains results from accelerator sled tests performed under Modification No. 3 of Contract No. DOT-HS-8-02045 for the research program entitled "Evaluation of Passive Belts for Different Size Occupants" performed by the Calspan Advanced Technology Center for the National Highway Traffic Safety Administration.

The NHTSA Contract Technical Monitor for the portion of the overall project effort reported herein was Mr. Lee Stucki of the Occupant Packaging Branch, Vehicle Engineering Research Division.

The opinions, findings and conclusions expressed in this publication are those of the author and not necessarily those of the National Highway Traffic Safety Administration.

This report has been reviewed and approved by:

John P. Andes, Vice President
Aeronautical and Transportation
Engineering Group
Calspan Advanced Technology Center

ADDENDUM

"Evaluation of Passive Belts for Different Size Occupants"

Contract No. DOT-HS-8-02045

Final Report Supplement

Some of the observations and conclusions given in the Final Report Supplement are not consistent with the observations made by NHTSA personnel and NHTSA research on the subject. The Agency recently completed a study entitled "Anthropomorphic Dummy Positioning and Repeatability Measurements" which conducted a detailed assessment of the repeatability of the proposed comfort zone compliance test. A total of forty trials were conducted in four vehicles (1980 Rabbit, 1979 Citation, 1979 Chevrolet pickup and 1980 Ford van) using two dummies (driver position) and two independent techniicans. The belt anchorage points were modified so that the belt centerline coincided with the belt fit zone centerline in the final equilibrium position.

As shown in Table 3 of this report, the maximum dislocation and standard deviation from the centerline of the zone along the upper and lower boundaries of the comfort zone of all the tests for each vehicle are as follows:

Vehicle	Upper (in)	Lower (in)	Standard Deviation (in)
Ford Van	0.625	0.375	0.153
Chevrolet Pickup	1.000	0.500	0.273
Citation	0.625	0.500	0.316
VW Rabbit	0.625	0.500	0.212

The belt fell within the comfort zone in all of the tests.

An additional task was conducted to assess the effect of deviations in the position of the dummy on the location of the torso belt within the belt fit zone. These tests were done with the Chevrolet pickup and included (a) raising the dummy one inch by placing a block beneath the pelvis, (b) applying a 50 pound force to the torso and abdomen of the dummy in the elevated position, (c) dummy is positioned one inch forward by inserting a block between the seat back and dummy, (d) dummy is pushed down in the seat by a 54 pound weight on the thighs, (e) combination of (b) and (d) and (f) a combination of (a) and (b). The maximum dislocation of the belt for any of these tests was 0.88 inches on the upper boundary and 0.44 inches on the lower boundary. Again, in all tests the belt fell within the comfort zone.

The results of this study show that the belt fit compliance test is, indeed repeatable even with the deviations in dummy seating position. The conclusions drawn in the Calspan report are in direct contradiction with these results and are based on limited observation.

Lee Stucki
Contract Technical Manager

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1. INTRODUCTION

In the research program entitled "Evaluation of Passive Belts for Different Size Occupants" performed by the Calspan Advanced Technology Center for the National Highway Traffic Safety Administration under Contract No. DOT-HS-8-02045, the effects of varying the location of the upper belt anchor on the performance of the Volkswagen passive belt restraint system was investigated and a device which allows vertical adjustment of the anchor was developed. The results of the Phase I and Phase II program efforts are documented in separate volumes of the final report covering each phase (References 1 and 2).

This report is a supplemental report containing results from fifteen additional sled tests of the Rabbit passive belt system with Part 572 50th percentile male anthropomorphic test dummies that were performed under a subsequent modification of the contract. The objective of the present series of tests was to assess the performance of the restraint system in 90 degree offside lateral, 30 degree oblique, and frontal impacts for several orientations of the belt on the dummy torso obtained by changing the locations of the anchor points. The test configurations included belts positioned so as to lie within the compliance envelope that has been proposed for incorporation in FMVSS 208 to assure proper fit of shoulder belts (Reference 3) and/or within a modified comfort zone defined by the NHTSA. For the new comfort zone, the lower 4 inch-long portion of the original zone is eliminated and the remaining portion (6 inches long) is enlarged by increasing the width at the upper end from 3 inches to 4 inches so as to make the zone trapezoidal in shape.

2. SLED TESTS

The equipment and methodology for these sled tests were generally the same as that employed in the earlier tests as described in Reference 1. One of the main differences, however, was the method used to establish the position of the belt on the dummy for a given set of upper and lower anchor point locations. For the earlier tests, which were completed before the procedures for determining compliance with belt fit requirements had been defined (Reference 3), the belts were placed in what appeared to be "natural" positions on the dummies which were clothed in cotton stretch garments. For the presently reported tests, the belt fit compliance test procedure was demonstrated by NHTSA personnel and was used to obtain the final belt positions. For this purpose, the dummy upper torso was unclothed but a large area was covered with cloth adhesive tape, on which the comfort zones were marked, to provide a relatively low friction surface for the belt contact. Belt loads also were not measured in any of the tests to insure that the belt final position was not affected by load cells attached to the webbing.

Descriptions of the test configurations and the results obtained in the sled runs performed for each of the three impact directions are presented in the following subsections.

2.1 90 Degree Offside Lateral Impacts

Four tests were performed using a dummy only in the driver seat and with the body buck oriented to simulate a 90° lateral impact on the passenger side. The acceleration pulse for these runs had a peak value of 8 G and a time duration of approximately 129 milliseconds which produced a velocity change of 13.7 MPH.

The belt configurations included the position obtained with baseline anchor points and with the anchors relocated so the belt was just inside the old comfort zone, just inside the new comfort zone, and nearly on the zone centerline. To facilitate changing the longitudinal location of the inboard anchor, the emergency locking retractor was mounted on a vertical plate fastened to the tunnel between the seats so the edge of the seat would not interfere with the belt. Considerable difficulty was encountered in attempting to determine the anchor locations that would produce the desired belt positions because the movement of the belt during rocking of the dummy was not consistent and repeatable. It was also found that the final position of the belt was influenced by whether the latch plate at the upper end of the belt was fixed (pointed aft) to the "boiler plate" anchor bracket or allowed to swivel about the attachment bolt. Since the release buckle is angled downward approximately 22 degrees in the VW Rabbit, the sled tests were performed with the latch plate loosely bolted so it also would be oriented at a downward angle.

The test results are given in Table 1 where the anchor locations, resulting belt geometry, and the measured dummy responses are tabulated for each test. It may be seen that the dummy response was not affected very much by the different belt positions which are shown in Figure 1. Moreover, the low values of the head and chest accelerations and HIC indicate that the simulated crash environment was not severe and unlikely to result in serious injuries to occupants on the far side of the vehicle in a side impact. The films of the tests show that the belt provided little or no restraint of the upper torso which leaned over laterally and escaped from the belt but the head of the dummy did not strike the door on the passenger side in any of the tests.

Time history traces of the data recorded in this series of four sled runs are presented in Appendix A.*

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*The magnetic tape containing the raw data from Run No. 2580 was inadvertently erased before processing with digital equipment. Dummy response values listed in Table 1 for this test were obtained from backup analog displays of the recorded data.

Table 1 SUMMARY OF RESULTS FROM 90° OFFSIDE LATERAL IMPACT TESTS

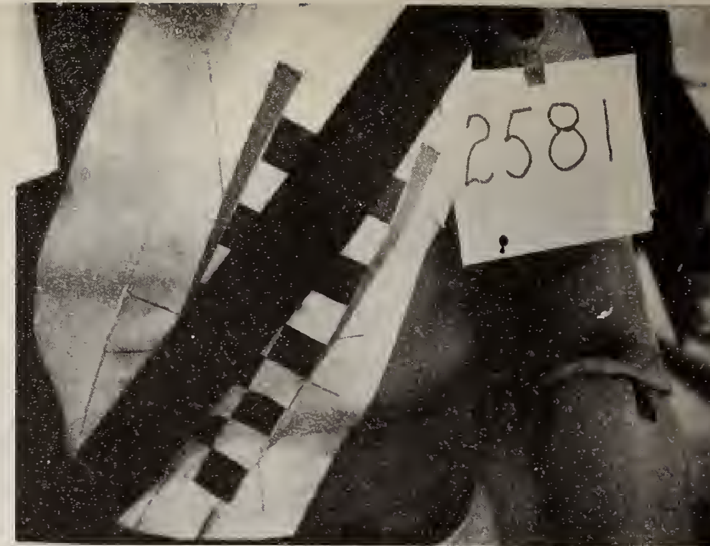
		Anchor Long. Location		Belt Geometry		HEAD		
Run No.	Desired Belt Position	Upper	Lower	Position in. (a)	Crossing Angle Deg.	Result, Accel. G	HIC	Chest Result. Accel. G (3 ms)
2580	With Base Anchors	Base	Base [b]	1.5	49.5	14.5	-	5.0
2581	Just Inside New Comfort Zone	8" Fwd	2.3" Fwd [c]	1.0	50	12.5	32	6.5
2582	Just Inside Old Comfort Zone	8" Fwd	5.6" Fwd [c]	0.3	48.5	15	35	7.4
2583	On Zone ℄	Base	9" Fwd [c]	0.3	53	12.5	31	6.8

(a) Distance above (+) or below (-) 16 in. sternum reference point of comfort zone.

(b) Anchor also approx. 2 in. inboard and 3 in. higher than normal installation under seat.

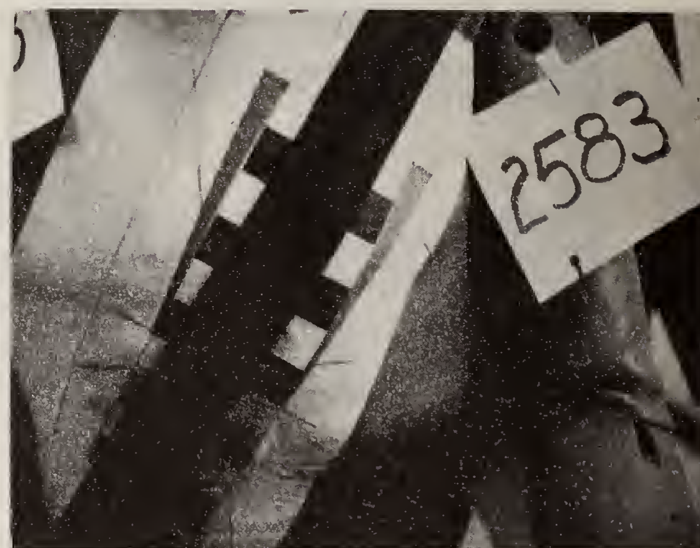
(c) Anchor also approx. 2 in. inboard and 6.5 in. higher than normal installation under seat.

(a) Baseline Anchors



(b) Just Inside New Zone

(c) Just Inside Old Zone



(d) Nearly on Zone ℄

Figure 1 BELT POSITIONS FOR 90° SIDE IMPACT TESTS

2.2 30 Degree Oblique Impacts

Three 30° oblique angle (acceleration in 1 o'clock direction) sled tests were performed with Alderson Part 572 dummies in both the driver and passenger seats. For these tests the sled velocity was nominally 31 MPH obtained with a crash pulse having a peak acceleration of 19.3 G and an overall time duration of 144 milliseconds.

It was found that the position of the belt on the driver dummy was different when the retractor was installed at the normal position under the seat rather than on the bracket at the side of the seat that had been used for the lateral impact tests. Hence, to permit a direct comparison of the belt geometry on the driver and passenger dummies in the first 30° oblique test with baseline anchors (Run 2589), both retractors were installed in the normal underseat location. For the other two tests, the inboard anchor for the driver belt was moved so the belt would lie, as closely as possible, on the centerline of the comfort zone (Run 2590) and just within the boundary of the old comfort zone (Run 2591). The upper anchor of both belts was at the baseline location for all tests except for the passenger of Run 2590 when the anchor point was 4 inches forward of the baseline.

Photographs showing the positions of the belts in relation to the comfort zones marked on the dummies are presented in Figure 2. It may be noted that in all cases the belt centerline was above the centerline of the comfort zone, particularly at the lower, inboard end. Comparing the belt positions on the driver and passenger dummies in Test No. 2589 with the anchors at the baseline location, it may be seen that the driver belt was just within the new comfort zone whereas the passenger belt crossed the torso at a slightly higher angle and was well inside the old zone. However in the subsequent test of the passenger with the same baseline anchor points (Run 2591), the belt assumed a final position that was barely in the old zone at the lower, inboard end.*

*Dummy Serial Nos. 818 and 819 occupied the driver and passenger seats, respectively, in all of the tests.

PASSENGER
BASELINE UPPER & LOWER ANCHORS

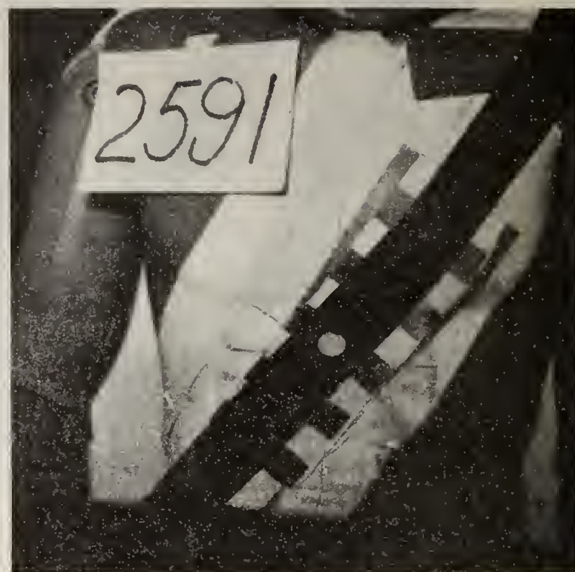
DRIVER
BASELINE UPPER & LOWER ANCHORS

PASSENGER
UPPER ANCHOR - 4" FWD
LOWER ANCHOR - BASE

DRIVER
UPPER ANCHOR - BASE
LOWER ANCHOR - 9" FWD

Figure 2 BELT POSITION IN RELATION TO COMFORT ZONES IN 30° OBLIQUE ANGLE SLED TESTS

PASSENGER
BASELINE UPPER & LOWER ANCHORS



DRIVER
UPPER ANCHOR - BASELINE
LOWER ANCHOR - 6.8" FWD

Figure 2 BELT POSITION IN RELATION TO COMFORT ZONES IN 30° OBLIQUE ANGLE SLED TESTS (Cont.)

There are a number of factors that could account for the noted discrepancies of belt position, including small differences in the position of the dummies in the seats although some care was taken to insure their placement was very nearly the same in all of the tests. Examination of the dummies revealed that the fit of the upper torso skin jackets of both dummies was such that the left shoulder was slightly higher than the right shoulder. This could be one reason for the different belt position on the two dummies in Run 2589 since the belts for the driver and the passenger pass over opposite shoulders.

The dummy responses, summarized in Table 2, were well below injury criteria values in all instances. It may be observed that, with few exceptions, differences among the results of the three tests for either the driver or the passenger are quite small. Also, the head and chest responses of the passenger are generally higher than those of the driver.

The films of the tests show that the belt was much more effective in restraining the passenger than the driver, a result that was expected in view of the direction of the acceleration vector. The kinematics of the passenger was very good and no belt loading of the neck was observed in any of the tests. The dummy head struck the aft edge of the vent window in the first two tests which produced a relatively high level spike in the acceleration response. It is of interest to note in Table 2 that the HIC number of the passenger was greatest for Run No. 2591 in which there was no such head contact. Each of the passengers struck the door which resulted in substantial permanent deformation of the door structure.

The belt came off the driver dummy shoulder as the torso moved inboard and forward out of the belt which then appeared to load the abdomen. The large excursion of the body resulted in head contact with the dash panel in Sled Run Nos. 2590 and 2591. In fact, the films of Test 2590 show the driver head protruded beyond the windshield opening. Contact of the upper torso with the inboard side of the steering wheel also occurred in both of those tests but does not appear to have been very severe. Although the

Table 2 SUMMARY OF RESULTS FROM 30° OBLIQUE IMPACT TESTS

Run No.	Desired Belt Position	Lower Anchor Location	Belt Geometry: Position in, (a)	Belt Geometry: Crossing Angle Deg.	Head: Result. Accel, G	Head: HIC	Chest Result. Accel. G (3 ms)	Femur Load, lb, Left	Femur Load, lb, Right	Notes
				DRIVER						
2589	With Base Anchors	Base	0.75	53	20,5	117	24,9	1060	720	
2590	On Zone ℄	9" Fwd [b]	0,5	52.5	84	248	34.4	1140	960	1
2591	Just Inside Old Comfort Zone	6.8" Fwd [b]	0.5	53	30.5	144	25.5	1000	900	1
				PASSENGER						
2589	With Base Anchors	Base	0.63	55	58.5	381	32.7	1020	N.A.	2
2590	On Zone ℄	Base [c]	0.5	53	75	448	42.5	1160	N.A.	2
2591	Just Inside Old Comfort Zone	Base	0,75	54	47,5	470	39.7	1080	960	

(a) Distance above (+) or below (-) 16 in. sternum ref. point of comfort zone.

(b) Lower anchor also approx. 2 in. inboard and 6.5 in. higher than normal installation under seat.

(c) Upper anchor 4 in. forward of baseline location.

NOTES: (1) Head hit dash panel.

(2) Head hit rear edge of vent window.

kinematic response and restraint effectiveness was clearly poor in all of the tests, the performance is judged somewhat worse as the inboard anchor was moved more forward of the baseline location.

Time histories of the data recorded in the 30° oblique angle sled tests are contained in Appendix B.

2.3 Frontal Impacts

Eight frontal impact tests were performed which included replicate tests for each of four belt positions on the driver and passenger dummies as follows: (1) the position obtained with baseline anchors, (2) just within the new comfort zone at the upper boundary, (3) on the zone centerline, and (4) just inside the new zone at the lower boundary. The sled acceleration pulse had a maximum value of about 27 G and produced a velocity of approximately 31.6 MPH in 94 milliseconds.

The tests were performed after first having determined the belt position on dummies installed in production VW Rabbit automobiles as described in Section 3 of this report. This was done to insure that the "correct" belt geometry would be duplicated in the sled tests of the baseline anchor configuration. The belt position on the dummies in the production vehicles was much different than had been obtained in applying the same belt fit compliance test technique for the previous sled tests with baseline anchorages. The location of the "boiler plate" upper anchor of the sled buck was therefore checked and found to closely match the location of the emergency release buckle button in the actual vehicle. However, it was thought that the different results for the belt position might be due to a difference in the angular orientation of the belt buckle latch plate. The belt attachment arrangement in the sled buck was therefore modified slightly by including a wedge so the latch plate would be yawed inward at the same angle (approximately 40 degrees) as the emergency release buckle installation in the vehicle.

Photographs illustrating the positions of the belts on the dummies for each of the four desired test configurations are presented in Figure 3. For the baseline anchor configuration, the procedure of rocking the dummies did cause the belts to ultimately move to the "correct" position that had been established by the production vehicle measurements. In this case the final position was rather well defined because after the belts moved off the tip of the shoulder they became trapped in the gap between the arm and shoulder and thus no further movement was possible. However, considerable difficulty was again encountered in attempting to determine the upper anchor locations that would produce the other desired belt final positions because of the sensitivity of the belt movement to small variations in the test setups. It was found, for example, that virtually imperceptible changes of the dummy position in the seat (e.g., adjusting the pitch angle or twisting the torso slightly) affected the final position assumed by the belt. As a result of this sensitivity, the belt position on the two dummies for a given test was usually different and the position on the same dummy in replicate tests also was not repeatable.

Since the belt was at the lowest of the desired positions in the first tests with baseline anchors, the next configuration tested was that for which the belt fell just inside the upper boundary of the new comfort zone. This was done to establish the range of upper anchor vertical locations within which the anchor points should be located for the remaining two intermediate belt positions required. The anchor point locations appropriate to each of the desired belt positions was determined on the basis of the results obtained with the passenger dummy. Movement of the belt was more consistent and repeatable with that dummy (Sierra S/N 111) than with the dummy used for the driver (Humanoid S/N 163) because the topography of the molded torso skin jacket was smoother. The upper anchor locations resulting in belt positions at the top, nearly on the centerline, and at the bottom of the new comfort zone marked on the passenger dummy were determined to be 2 in., 1.4 in. and 0.6 in. above the baseline anchor location, respectively. The driver dummy (and the passenger dummy also for the replicate tests) was adjusted in the seat slightly as required to cause the belt to move to the desired position for each test.

PASSENGER

DRIVER

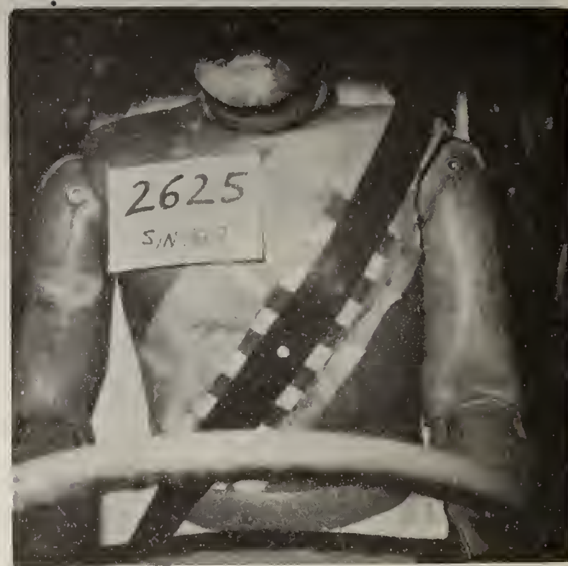
BASELINE ANCHORS

PASSENGER

DRIVER

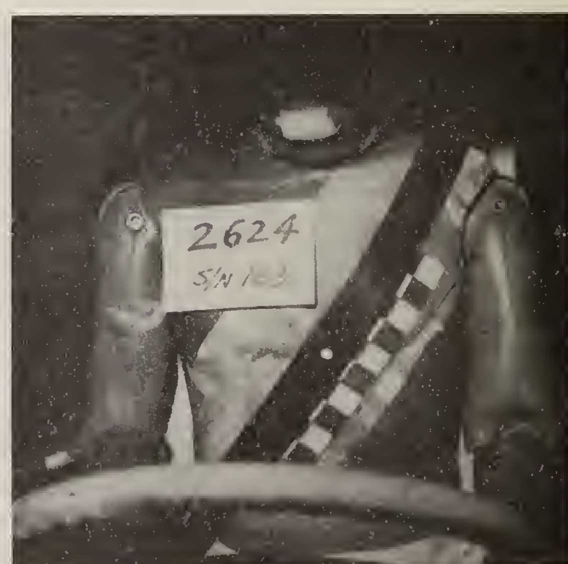
UPPER ANCHOR RAISED 0.6 IN. - BELT INSIDE
NEW COMFORT ZONE AT LOWER BOUNDARY

Figure 3 BELT POSITIONS IN RELATION TO COMFORT ZONES FOR FRONTAL IMPACT SLED TESTS



PASSENGER DRIVER

UPPER ANCHOR RAISED 1.4 IN. - BELT ON COMFORT ZONE ℄



PASSENGER DRIVER

UPPER ANCHOR RAISED 2 IN. - BELT INSIDE
NEW COMFORT ZONE AT UPPER BOUNDARY

Figure 3 BELT POSITIONS IN RELATION TO COMFORT ZONE
FOR FRONTAL IMPACT SLED TESTS (Cont'd)

However, in several instances it was not possible to obtain the proper position on the driver dummy so the belt was manually placed in the zone to match the passenger.

The results from the frontal impact tests are summarized in Table 3 and time history plots of the recorded data are contained in Appendix C. The tabulated data shows that the head and chest responses of both dummies were well below injury criteria values in every test and that the driver results were consistently higher than those of the passenger, probably due to contact with the steering wheel.

Although very good agreement is generally exhibited by the data from replicate tests, the data scatter is sufficient to preclude positive identification of trends in the responses as a function of the belt position on the dummies. However an analysis and comparison of the passenger chest accelerometer time history records for all of the tests does reveal some response differences and a trend associated with changes of the belt geometry. It may be observed that in the tests both with the baseline anchors (Runs 2622 and 2623) and with the belt positioned low in the comfort zone (Runs 2627 and 2629) the passenger peak chest resultant acceleration results from spikes in the X and Y accelerometer traces that occurred at approximately 90 milliseconds. The largest component of the peak resultant acceleration was in the "Y" direction. In contrast, the maximum chest resultant acceleration in each of the other tests with the belt positioned on the centerline (Runs 2625 and 2626) or high in the zone (Run 2624 and 2628) occurred at about 60 milliseconds and the "X" component was largest. Again, the data traces contain characteristic "glitches" of smaller magnitude at approximately 90 milliseconds which clearly are evidences of some phenomenon that occurred in each test, but to a lesser degree as the belt crossed higher on the torso. If the peak accelerations associated with this phenomenon are excluded, the data from all of the tests show a clear trend of increasing values of the maximum chest resultant acceleration with higher belt positions and crossing angles.

Table 3 SUMMARY OF RESULTS FROM FRONTAL IMPACT TESTS

Run No.	Desired Belt Position	Upper Anchor Location	Belt Geometry: Position in. (a)	Belt Geometry: Crossing Angle Deg.	Head: Result. Accel. G (3 ms)	Head: HIC	Chest Result. Accel, G (3 ms)	Femur Load, Lb.: Left	Femur Load, Lb.: Right	Notes
				DRIVER						
2622	With Base Anchors	Base	-2.3	46	53.1	363	42.1	1200	1180	1
2623	With Base Anchors	Base	-2.2	49	56.3	402	41.5	1260	1275	1
2627	Just Inside New Zone at Bottom	0.6" Up	-1.0	50.5	47.0	381	37.1	1360	1260	1
2629	"	0.6" Up	-1.0	51	64.4	328	48.9	1550	1440	1,3
2625	On Zone ℄	1.4" Up	-0.1	54	47.1	354	37.0	1350	1340	1
2626	"	1.4" Up	0	53	47.4	354	35.3	1120	890	1
2624	Just Inside New Zone at Top	2.0" Up	0.9	57	52.1	414	43.3	1500	1170	-
2628	"	2.0" Up	1.2	56	55.3	555	42.9	1500	1440	-
				PASSENGER						
2622	With Base Anchors	Base	-2.4	44	32.5	167	27.6	860	1470	2
2623	With Base Anchors	Base	-2.3	44.5	38.6	209	37.2	1080	1550	2
2627	Just Inside New Zone at Bottom	0.6" Up	-1.0	50	35.9	179	34.8	960	1420	2
2629	"	0.6" Up	-0.9	53	32.5	175	32.4	800	1500	2
2625	On Zone ℄	1.4" Up	-0.1	56	33.3	164	31.9	1030	1200	2
2626	"	1.4" Up	0.1	53	28.6	156	31.8	710	1520	2
2624	Just Inside New Zone at Top	2.0" Up	1.2	56	35.7	242	34.4	920	1440	-
2628	"	2.0" Up	1.3	55	37.3	250	34.0	800	1140	2

(a) Distance above (+) or below (-) 16 in. sternum ref. point of comfort zone.

NOTES: 1. Head hit steering wheel.
2. Rib underride.
3. Belt webbing broke.

Analysis of the test films reveals a trend in the kinematic response of the passenger dummy and also provides a possible explanation of the source of the characteristic disturbances observed in the chest acceleration data at 90 milliseconds. As may be seen in the sequence photographs of Figure 4, the kinematics were improved as the belt was positioned higher on the torso. However, as noted in Table 3, even in the test with the belt just within the upper boundary of the comfort zone, the tendency for the torso to twist outboard and roll over the belt so as to produce loading of the lower abdominal region is evident. Although unable to be confirmed from observation of the high-speed movie films, it is believed that the aforementioned "glitches" in the chest acceleration data are indications of the belt suddenly slipping off the lower rib during rotation of the torso and thereby resulting in a rapid change of the applied belt load. This appears to be a plausible explanation of the phenomenon based on the orientation of the dummy at about 90 milliseconds.

Analysis of the driver responses also points to somewhat improved restraint system effectiveness with the belt positioned just inside the top of the comfort zone compared to the other positions tested. In both tests with the belt highest in the zone the forward excursion of the head and torso was less and the head did not strike the steering wheel as it did in each of the other tests. It is of interest to note that the largest values of the HIC number were obtained when head contact did not occur and that the lowest HIC number was recorded in the test in which head contact was most severe (at least in terms of the peak head resultant acceleration) as a result of the failure of the belt webbing.*

Analysis of the driver chest resultant acceleration data records shows that the peak acceleration occurred earliest when the belt was positioned highest in the comfort zone. It is reasoned that the early maximum acceleration

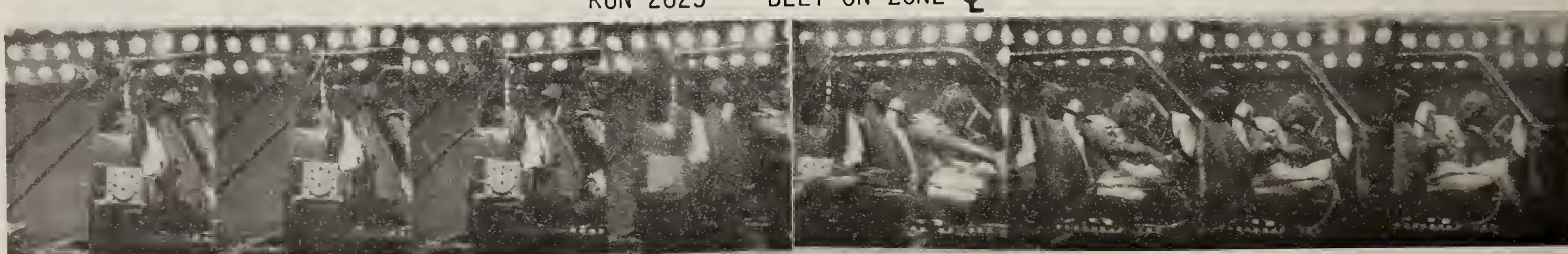
---

*Belt failure is believed to have been caused by cutting of the webbing on a corner of the shoulder yoke when the belt entered the gap between the shoulder and upper arm. Post-test inspection showed the belt to be similarly partially cut in Run No. 2622.

RUN 2622 BASELINE ANCHORS

RUN 2627 BELT LOW IN COMFORT ZONE

RUN 2625 BELT ON ZONE ℄



RUN 2624 BELT HIGH IN COMFORT ZONE

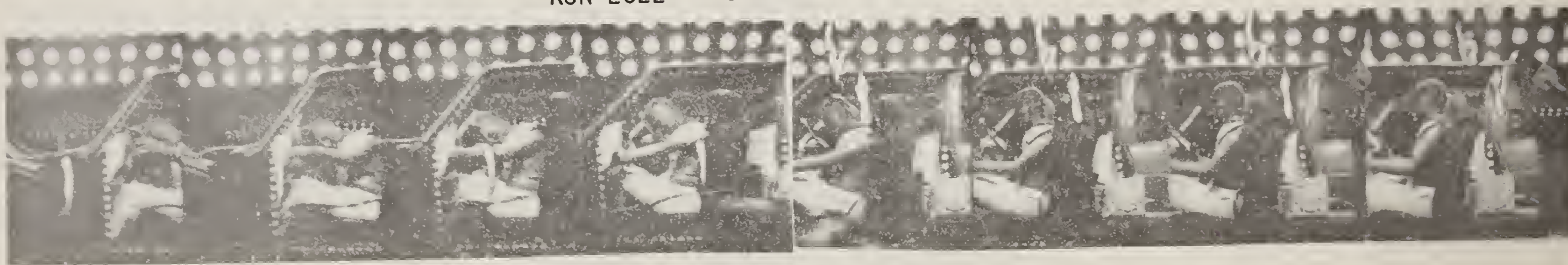
TIME ⟶

Figure 4 PASSENGER DUMMY KINEMATICS

in this case was the direct result of belt restraining forces on the torso whereas, with the belt lower in the zone, the belt was less effective and the maximum acceleration (though lower) was produced somewhat later when the torso contacted the steering wheel.

Sequence photographs showing the kinematics of the driver are presented in Figure 5.

RUN 2622 BASELINE ANCHORS



RUN 2627 BELT LOW IN COMFORT ZONE

RUN 2625 BELT ON ZONE ℄

RUN 2624 BELT HIGH IN COMFORT ZONE

← TIME

Figure 5 DRIVER DUMMY KINEMATICS

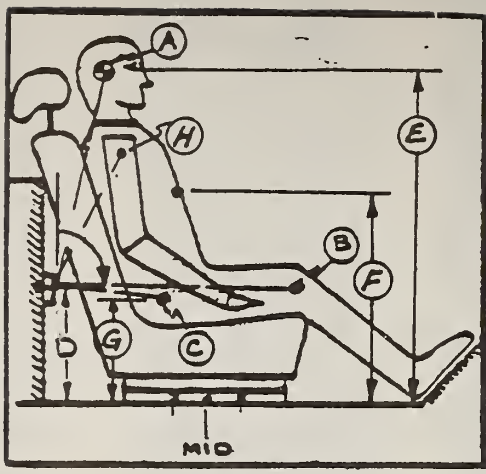
3. PRODUCTION VEHICLE MEASUREMENTS

A series of tests was performed to determine the belt geometry on dummies installed in a production 1976 VW automobile equipped with passive belts. For these tests, the procedures of FMVSS 208 were followed in placing the dummies in the seats and for determining compliance with comfort zone fit requirements except that the upper torsos were unclothed. The comfort zones were marked on large pieces of adhesive cloth (medical Montgomery straps) applied to the torso and shoulder of the dummies which provided a form-fitting, low-friction surface for contact by the belt.

The seat backs were adjusted to approximately the same angle as in earlier sled tests (front surface 20 degrees from the vertical) and measurements of the dummy positions in the vehicle were made with a device attached to the door latch stud on the B-pillar which measured the vectors (distance and angle in the longitudinal vertical plane) from the reference stud to several points on the dummies. In addition, vertical dimensions from the sill to the head target, the 16 in. sternum reference point, and the hole in the flesh of the lower torso representing the H-point, were also measured. These measurements are illustrated in the sketch of Figure 6.

The first set of data was obtained with one of a pair of Alderson dummies as the driver and the other as the passenger. After determining the belt positions in relation to the comfort zones, the dummies were interchanged in the seats and the measurements repeated. This, of course, required re-marking of the comfort zones since the belts for the driver and passenger cross over opposite shoulders.

The measurements of dummy position in the vehicle are given in Table 4. These data indicate that the variation in the four placements of the dummies typically was about 0.5 inches or less. It should be noted that the variation in the linear and angular measurements for vectors A, B, C and H can be a reflection of differences in the horizontal as well as the vertical positions of the dummies.



DIMENSION

A - HEAD TARGET VECTOR
B - KNEE JOINT VECTOR
C - H POINT VECTOR
D - SILL TO REFERENCE POINT VERTICAL
E - HEAD TARGET VERTICAL
F - STERNUM REFERENCE POINT VERTICAL
G - H POINT VERTICAL
H - SHOULDER JOINT VECTOR

Figure 6 DUMMY POSITION MEASUREMENTS

Table 4

DUMMY POSITION MEASUREMENTS

Dimension ~ in.[1]	Driver		Passenger	
	Dummy 818	Dummy 819	Dummy 818	Dummy 819
A	20.6 (28)	20.5 (29)	20.4 (26)	20.8 (29)
B	32.4 (103)	32.4 (106)	32.5 (102)	32.8 (100)
C	18.5 (123)	18.5 (125)	18.8 (120)	18.1 (118)
D	16.4	16.4	16.6	16.6
E	33.8	33.8	34.0	34.2
F	20.4	19.9	20.3	20.2
G	5.6	6.2	7.1	5.9
H	12.0 (35)	12.4 (36)	12.9 (35)	13.6 (35)

Note: (1) Values in ( ) are vector angles from vertical, degrees.

The final position assumed by the belt was determined three times for each dummy as both the driver and the passenger. (Each dummy was placed in each seat only once.) In each of the total of twelve tests the belt moved off of the tip of the shoulder and became trapped in the gap between the shoulder and upper arm.* Photographs showing the typical position of the belts are presented in Figure 7 where it may be seen that the belts crossed low on the torso and did not fall within the comfort zone. Measurements of the belt geometry show that the belts crossed the torsos about 2-3/4 inches below the 16 in. sternum reference point at an angle of approximately 43 degrees.

*Movement of the belt off the shoulder was confirmed in trials by NHTSA personnel with a dummy installed in the same car as well as in a 1980 model 2-door passive belt Rabbit.

Figure 7 PASSIVE BELT POSITION ON DUMMIES IN 1976 VW RABBIT AUTOMOBILE

4. CONCLUSIONS

The principal findings and conclusions drawn from the tests performed in this study are summarized as follows:

1. The belt is ineffective in restraining the upper torso of occupants on the far side of the vehicle in a 90 degree side impact and the occupant response is little affected by relocation of the belt anchors forward of the baseline position.

2. In 30 degree oblique impacts, some protection is provided by the belt to occupants in seats opposite the impacted side but the upper body escapes from the belt and may result in head contact with the forward interior. The occupant kinematic response was poor in each of the three tests performed but was observed to be worse as the inboard anchor was moved further forward. In contrast, very good restraint performance was demonstrated for the dummies in the near-side seat. Although the dummies contacted the door interior panel and window, injury criteria values were well below allowable limits and no loading of the neck by the belt occurred in any of the tests.

3. The results of the frontal impact tests show a consistent trend of improved restraint system performance, in terms of a reduced tendency for the occupants to roll over the belt, as the belt was positioned higher and at a steeper angle on the torso. Using the belt fit compliance test procedures, elevating the outboard anchor 2 inches above the baseline location caused the belt to be positioned just inside the upper boundary of the comfort zone at an angle of about 56 degrees. Earlier tests performed in Phase I of the program (Reference 1) indicated that better restraint system performance was obtained with the 50th percentile male size dummy when the belt crossed higher on the

torso at this angle. However, the performance for larger occupants was then degraded because of belt loading of the neck. Therefore, it may be concluded that the new comfort zone allowed the Rabbit passive belt to be positioned close to the optimum for performance by changing the vertical location of the upper anchor. Although no test data are available to provide confirmation, it is believed that the effectiveness of the restraint system might be improved if the belt geometry was such as to cross lower on the torso but at a steeper angle (as permitted by the zone). This would improve the belt position over the shoulder of the 50th percentile size occupant by reducing the moment of the belt force tending to cause the occupant to twist out of the belt and perhaps also would not adversely affect system performance for other size occupants.

4. Based on the experiences of this program which show that the belt fit compliance test procedures do not produce repeatable results for the final position of the belt in replicate tests of dummy setups, the usefulness of the procedures as a compliance test standard must be seriously questioned. The movement of the belt is very sensitive to conditions that exist in the contact area between the belt and the dummy such as the friction and the detailed topography of the dummy surface. For this reason, slight changes of the dummy position or differences of the molded shape of the torso skin jacket of Part 572 dummies made by different manufacturers affect the final position of the belt. Belt movement is also affected by operator technique such as, for example, the amplitude and frequency of rocking the dummy and the number of cycles and the sequence in which the dummy is rocked in the lateral and fore-aft directions.

The results of the tests with dummies seated in production VW Rabbits showing that the belt passes low over the torso and outboard of the shoulder are in sharp contrast with the author's observations, albeit quite limited, of the path of belts worn by human occupants of the vehicle which nearly always appeared to be much better positioned over the shoulder. Therefore, the author is doubtful as to whether the belt fit compliance test procedure yields results that are correct with respect to properly representing the position of the belts as typically worn by motorists.

5. REFERENCES

1. DeLeys, Norman J., "Evaluation of Passive Belts for Different Size Occupants," Phase I Final Report, Calspan Report No. 6407-V-1, April 1980.

2. DeLeys, Norman J., "Evaluation of Passive Belts for Different Size Occupants," Phase II Final Report, Calspan Report No. 6407-V-2, September 1980.

3. "Federal Motor Vehicle Safety Standards; Improvement of Seat Belt Assemblies," 49 CFR Part 571 (Docket No. 74-14; Notice 17), Federal Register, Volume 44, No. 251, December 31, 1979.

APPENDIX A

90 DEGREE LATERAL IMPACT SLED TEST DATA RECORDS
SLED RUN NOS. 2581-2583

Sequence of Data Records

Driver		Filter Channel Class
Head	- HIC, X, Y, Z, Resultant Accelerations	1000
Chest	- X, Y, Z, Resultant Accelerations	180
Femur Load	- Left, Right	600
Sled Acceleration		60

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2581

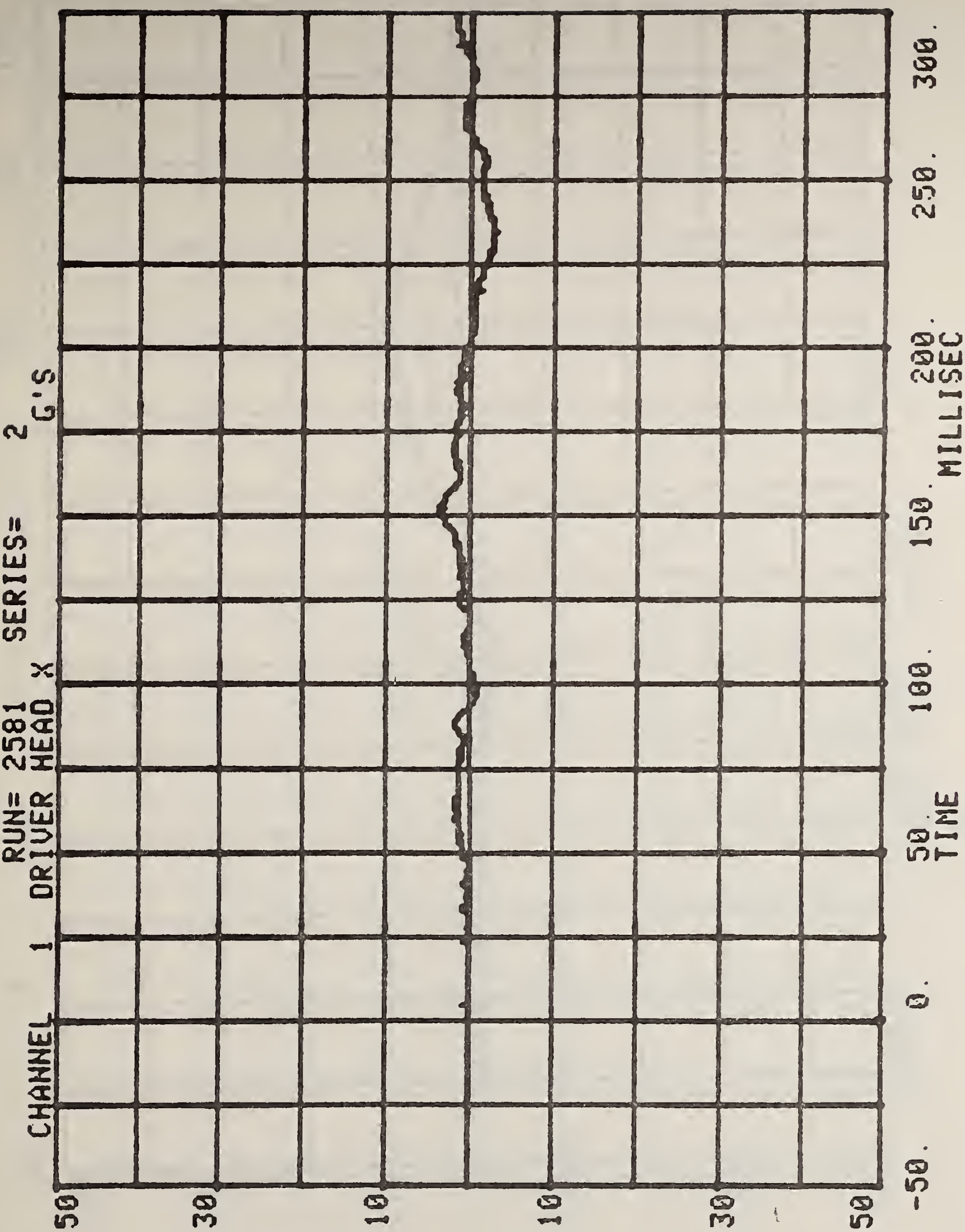
DRIVER HEAD RESULT.

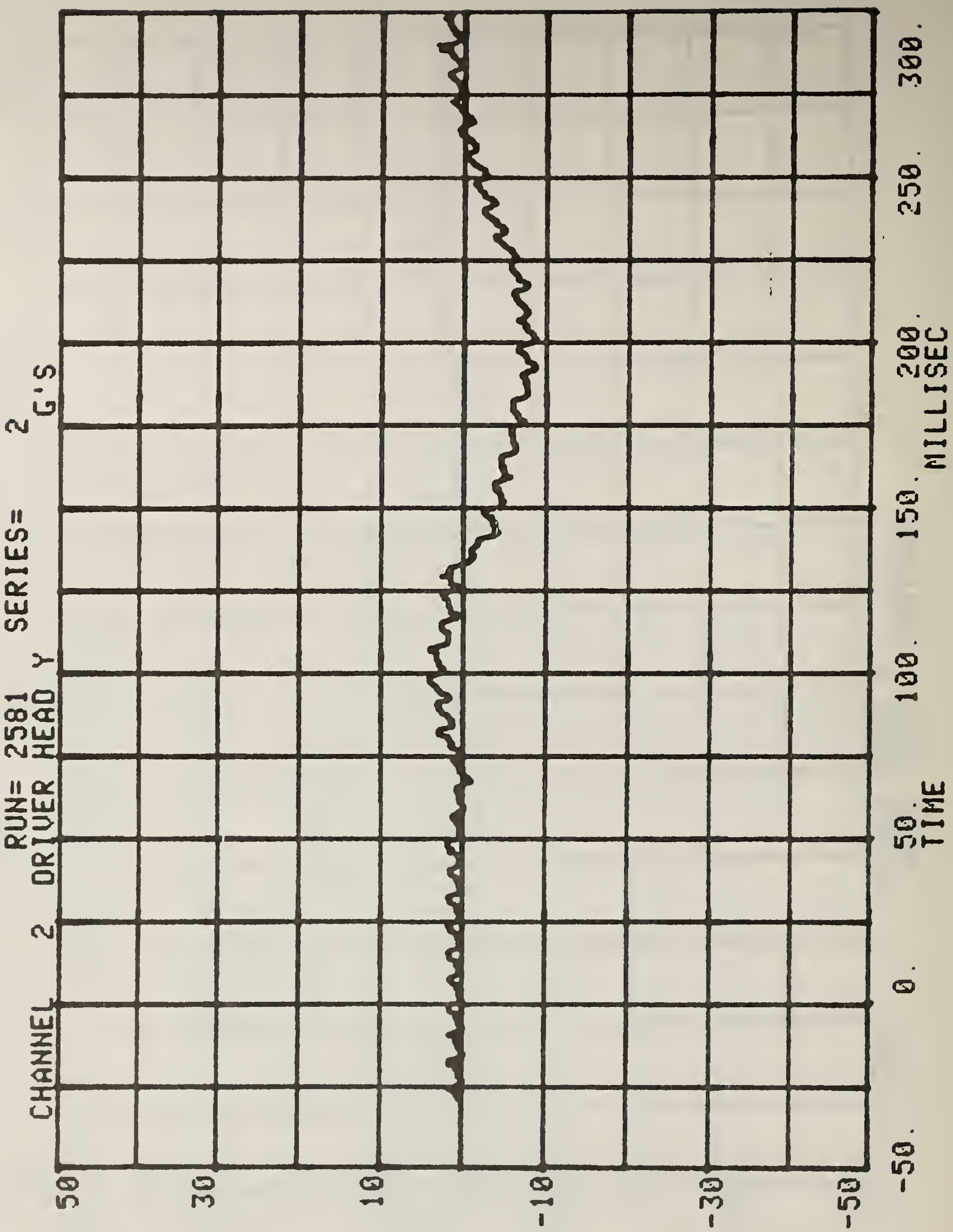
HIC= 32.2 FROM T1= .10650 TO T2= .23040

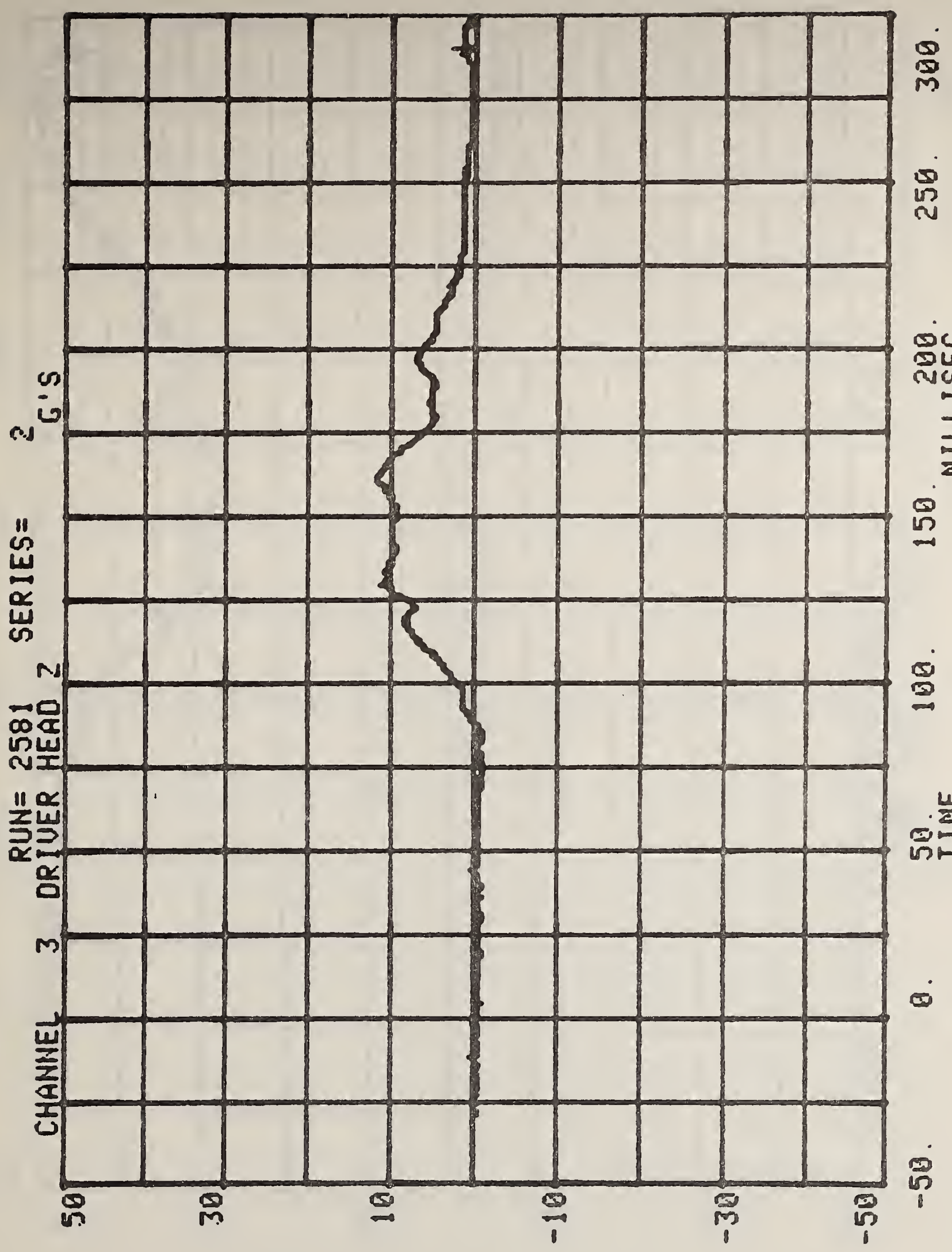
AVERAGE ACCELERATION BETWEEN T1 AND T2= 9.2G'S

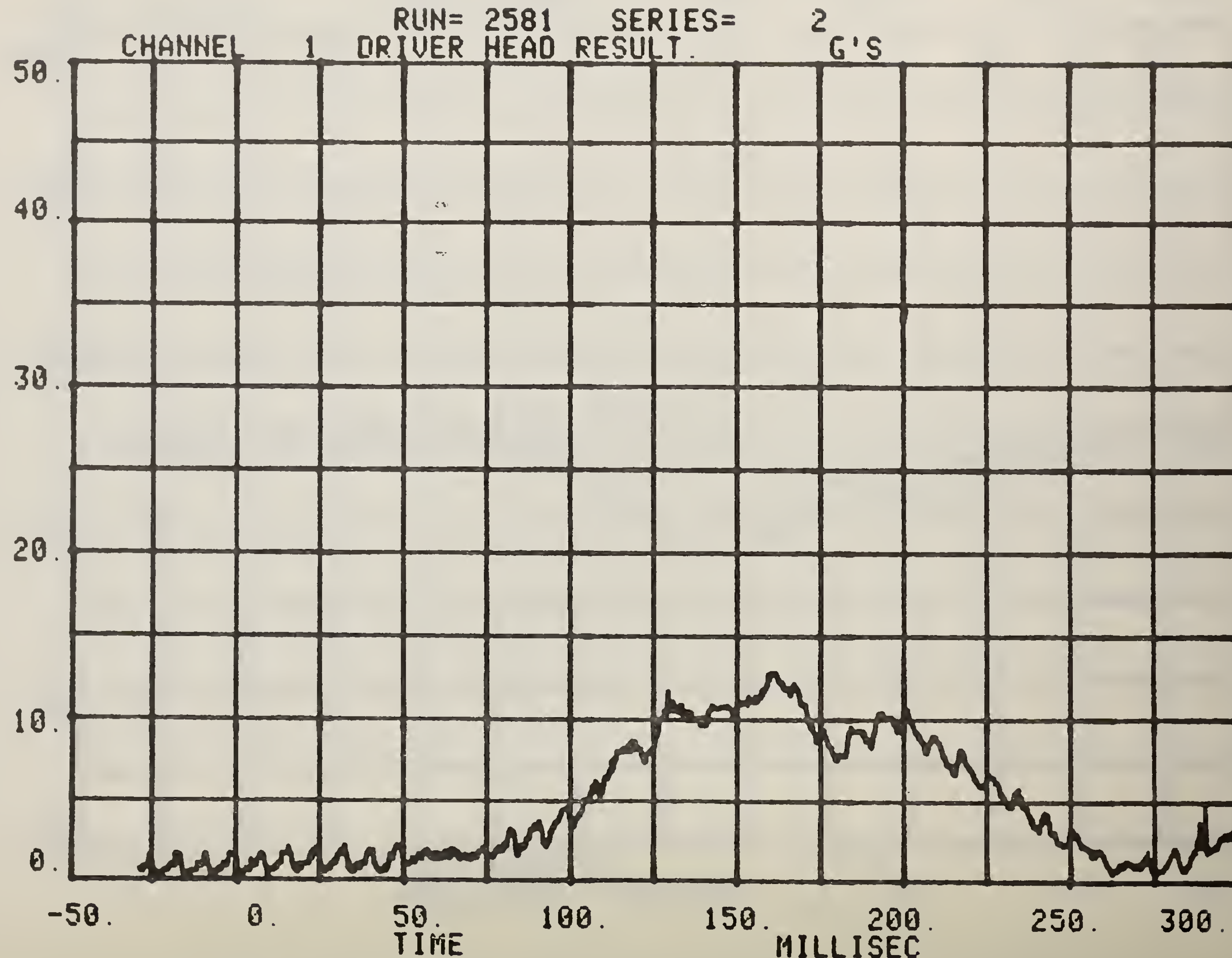
EVENT TIME= 300.0 MSEC

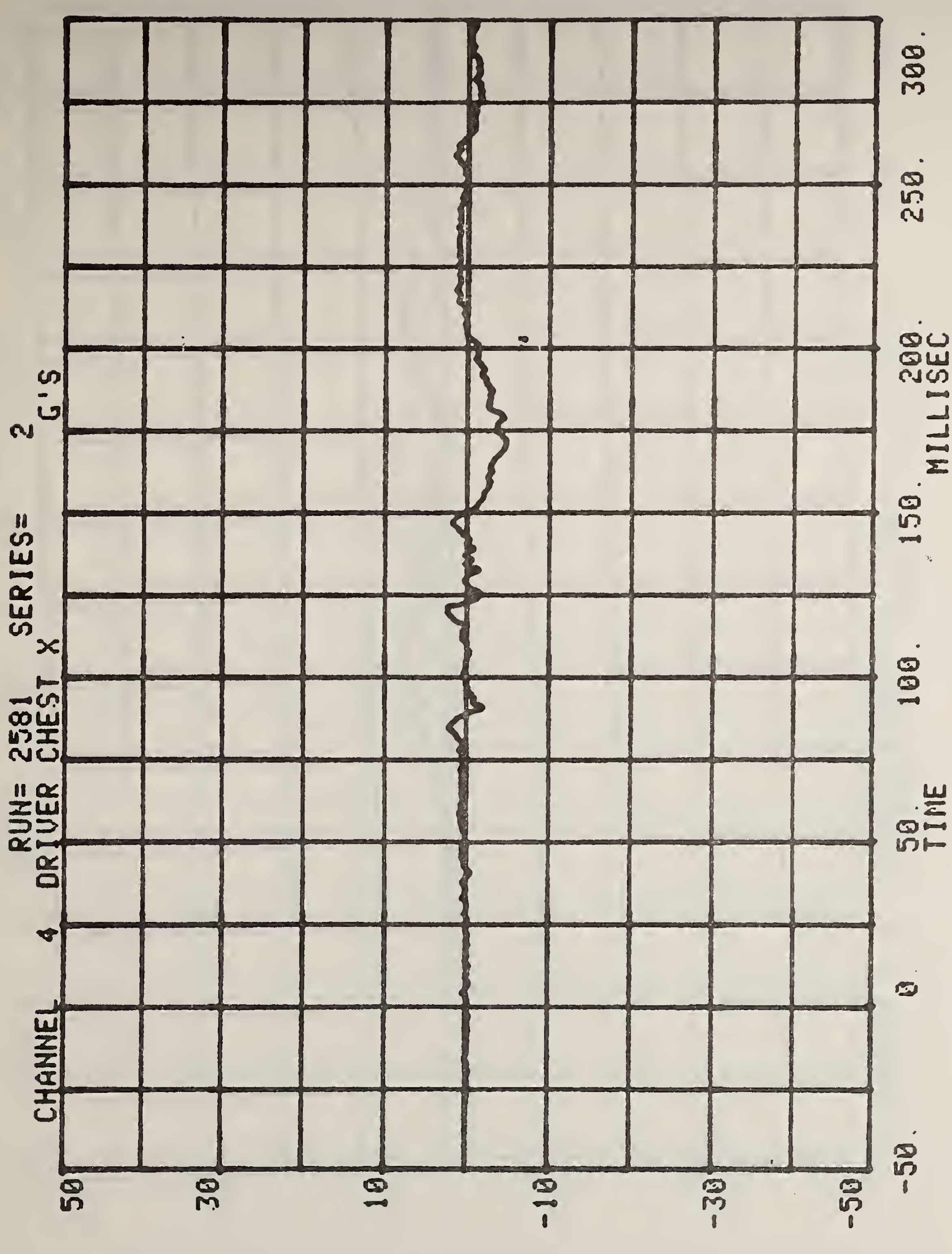
SEVERITY INDEX= 36.3

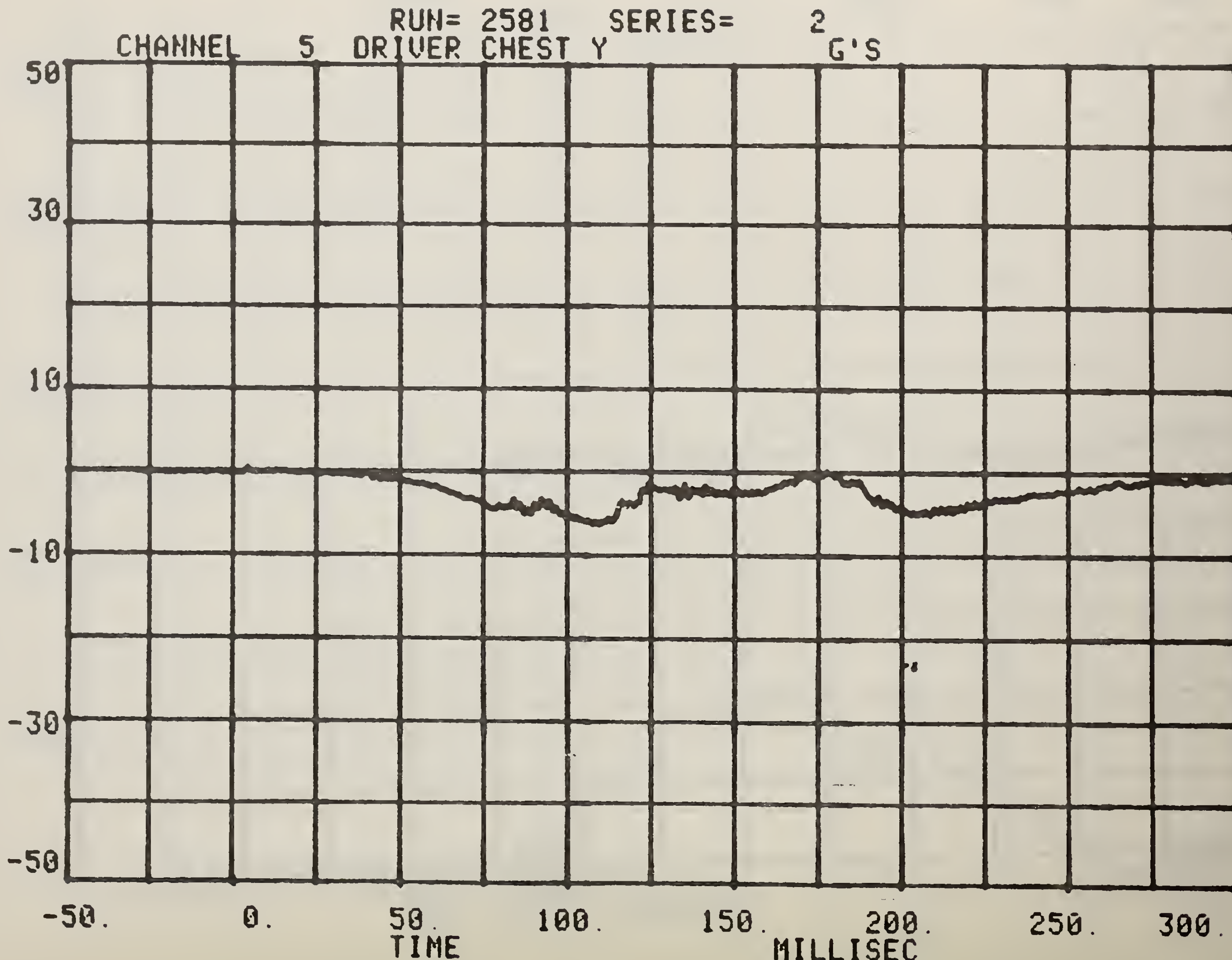

CHANNEL 1 RUN= 2581 SERIES= 2
DRIVER HEAD X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

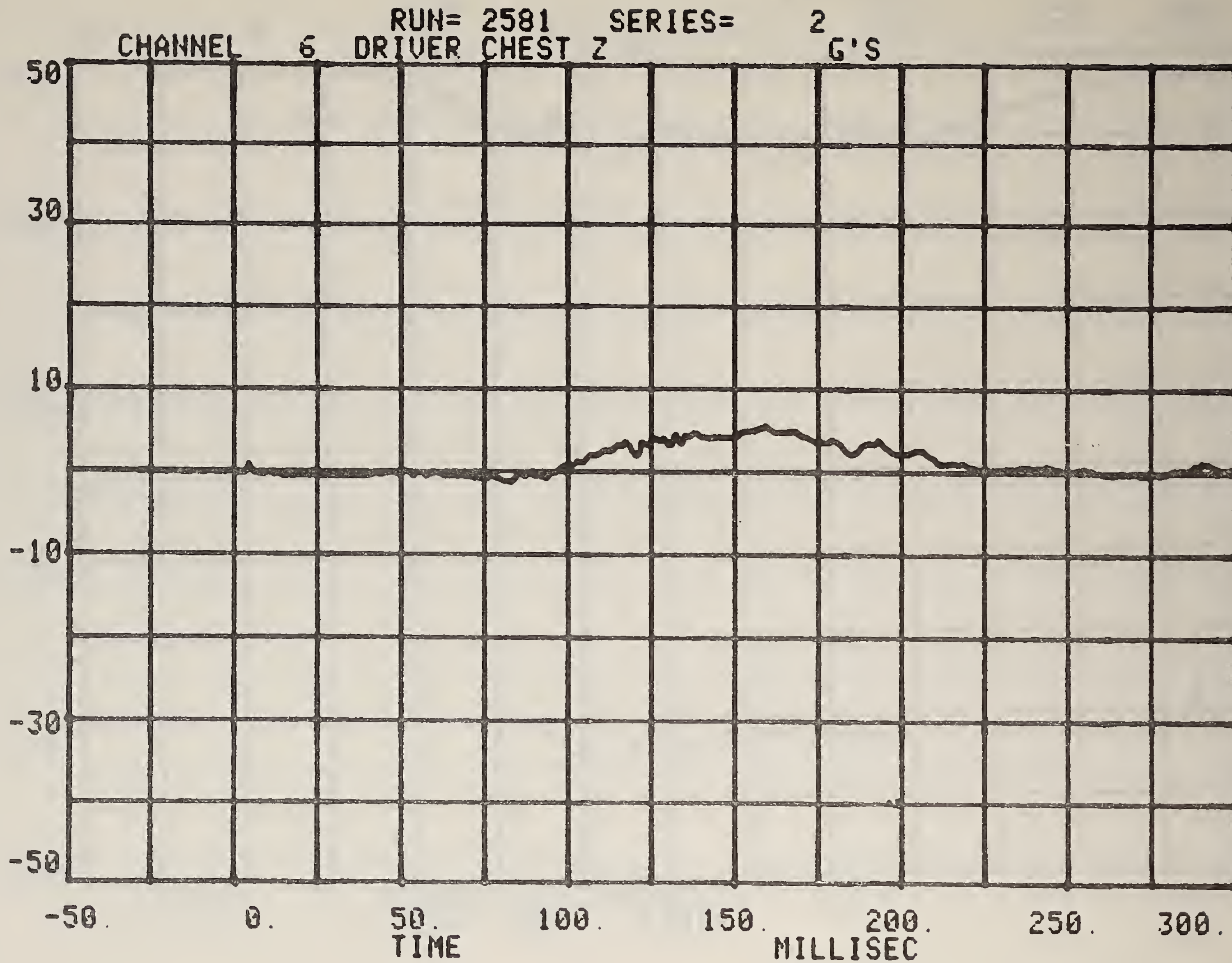

CHANNEL 2 RUN= 2581 SERIES= 2
DRIVER HEAD Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

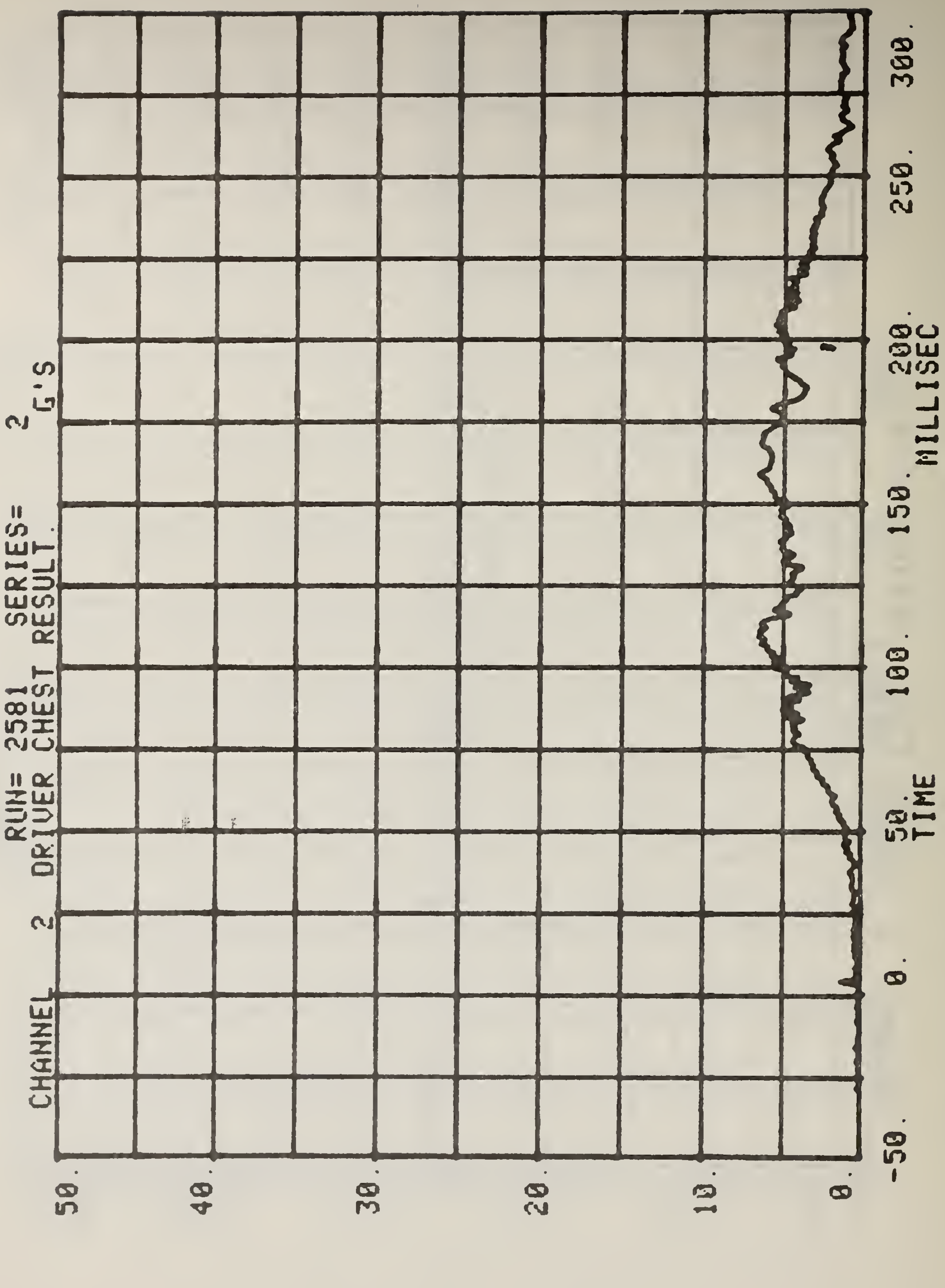

CHANNEL 3 RUN= 2581 SERIES= 2
DRIVER HEAD Z G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

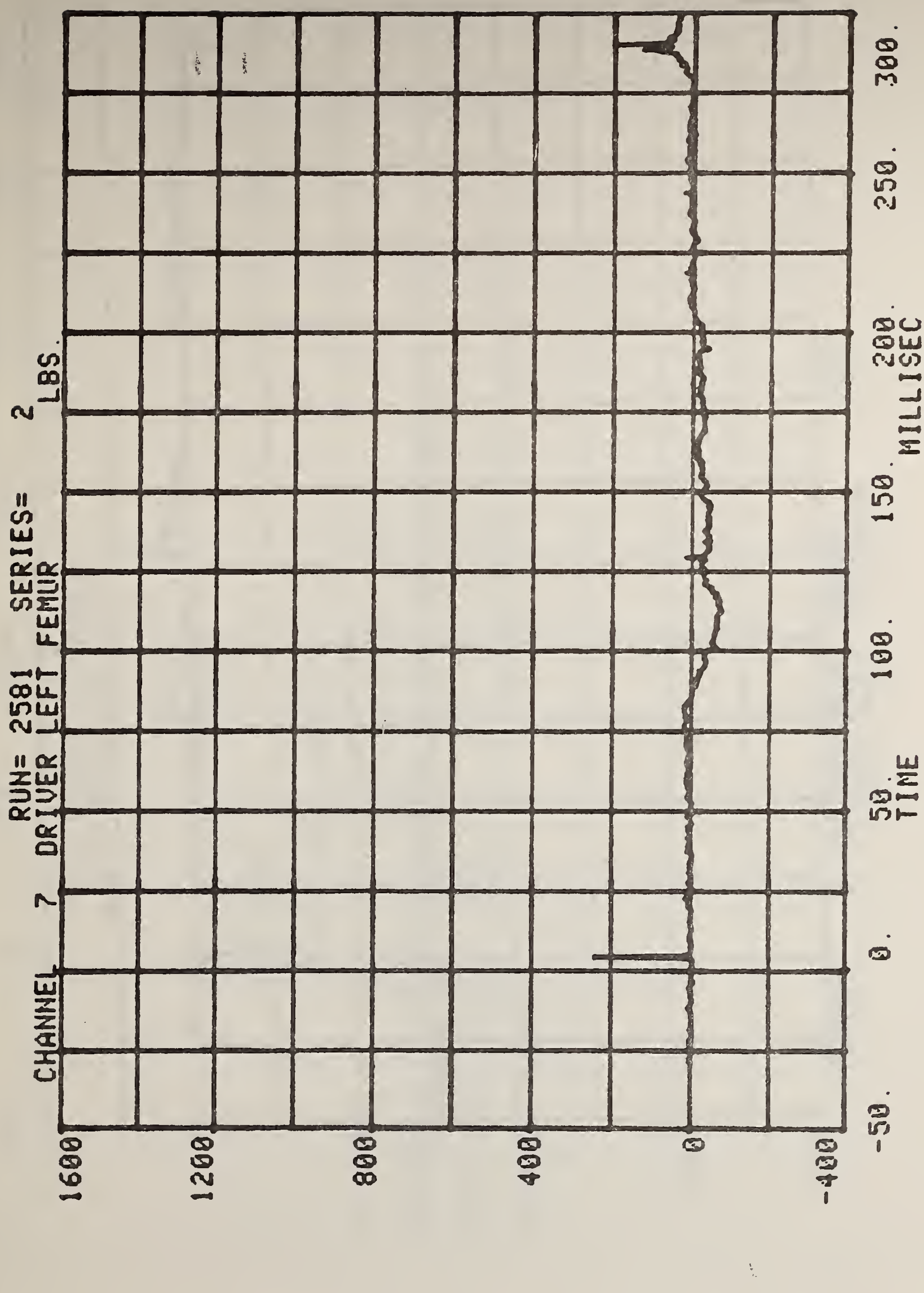

RUN= 2581 SERIES= 2
CHANNEL 1 DRIVER HEAD RESULT. G'S
50.
40.
30.
20.
10.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

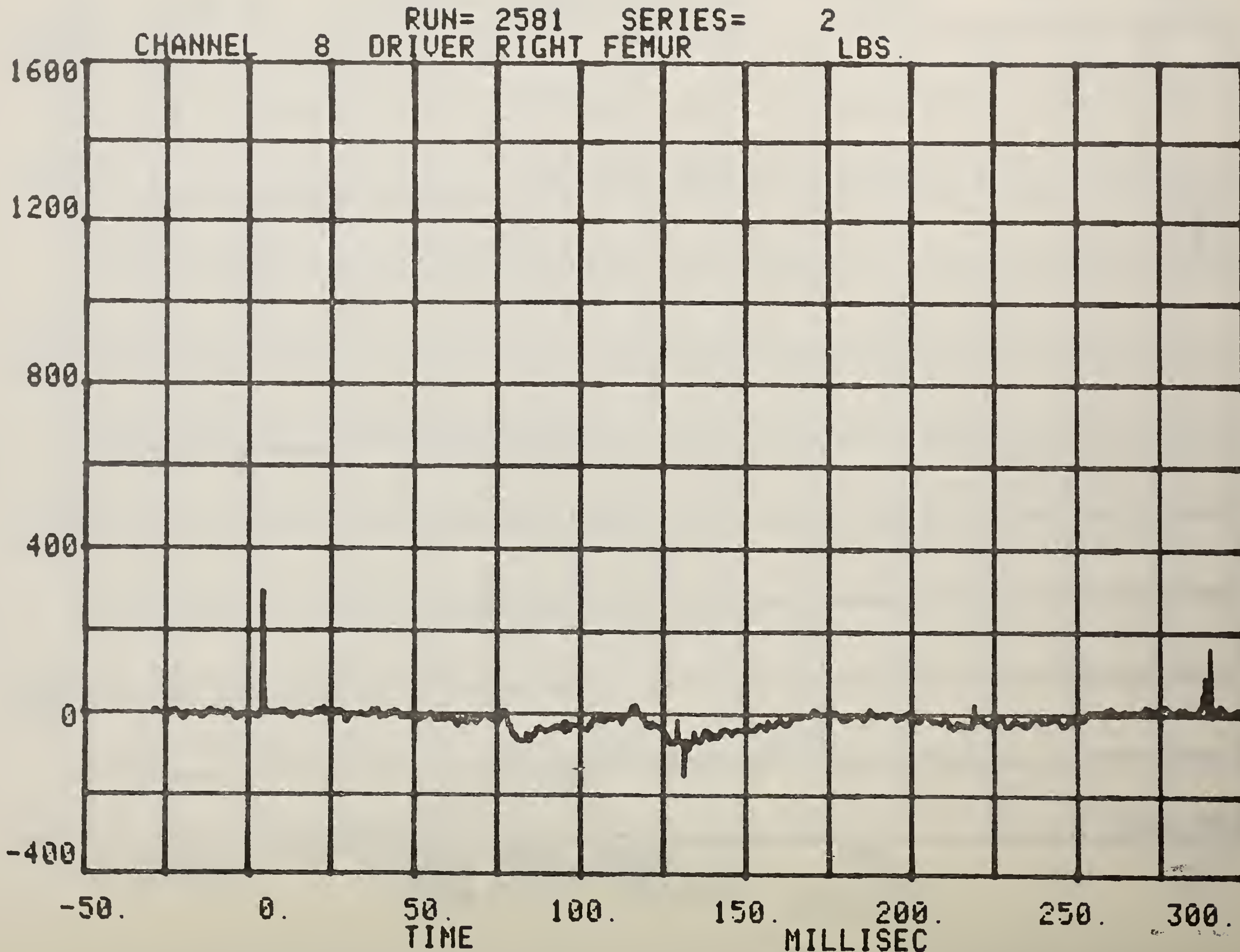

CHANNEL 4 RUN= 2581 SERIES= 2
DRIVER CHEST X G'S
50
30
10
-10
-30
-50
-50.
0
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2581 SERIES= 2
CHANNEL 5 DRIVER CHEST Y
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2581 SERIES= 2
CHANNEL 6 DRIVER CHEST Z G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 2 RUN= 2581 SERIES= 2
DRIVER CHEST RESULT. G'S
50.
40.
30.
20.
10.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 7 RUN= 2581 SERIES= 2
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



RUN= 2581 SERIES= 2
CHANNEL 8 DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2582

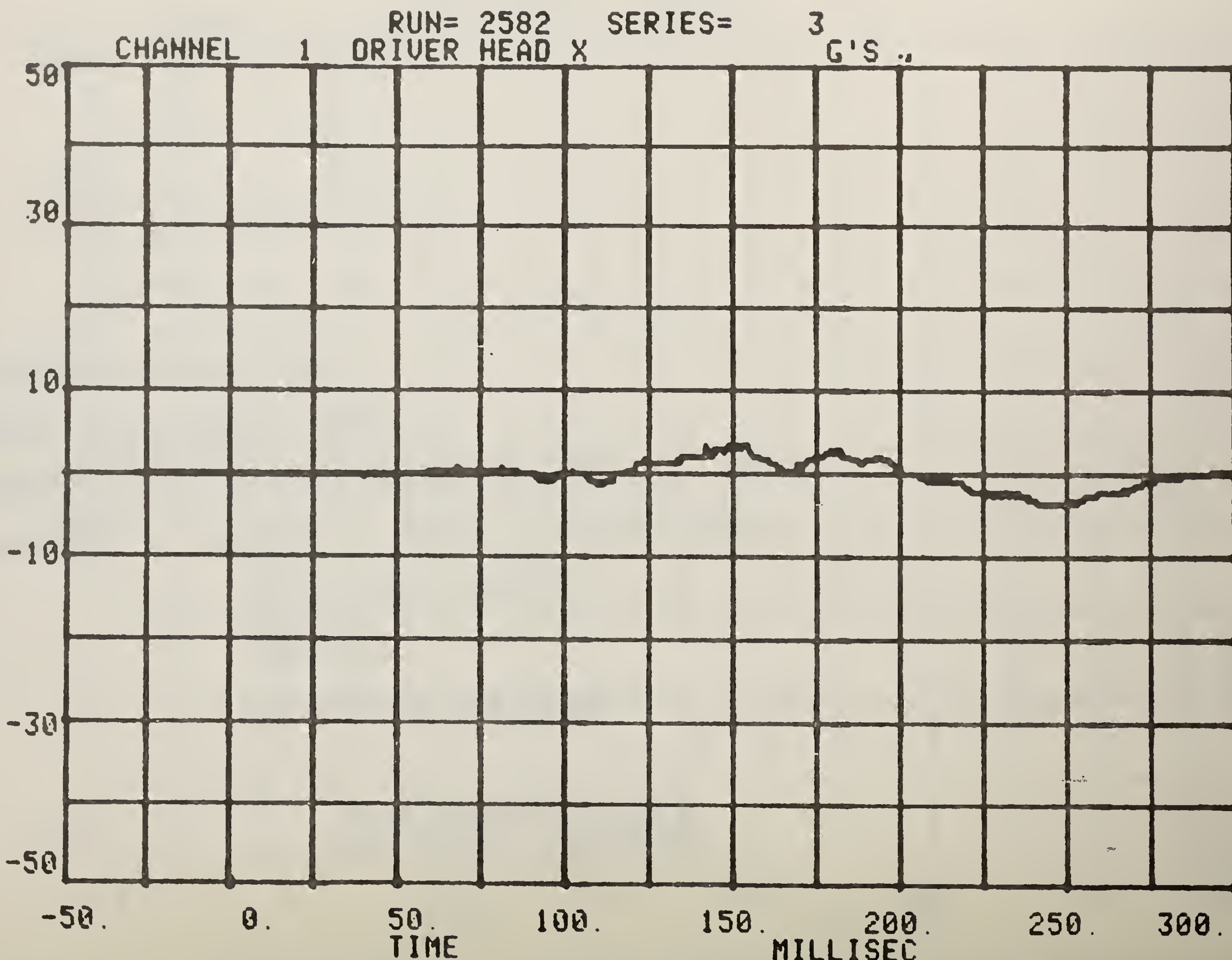
DRIVER HEAD RESULT.

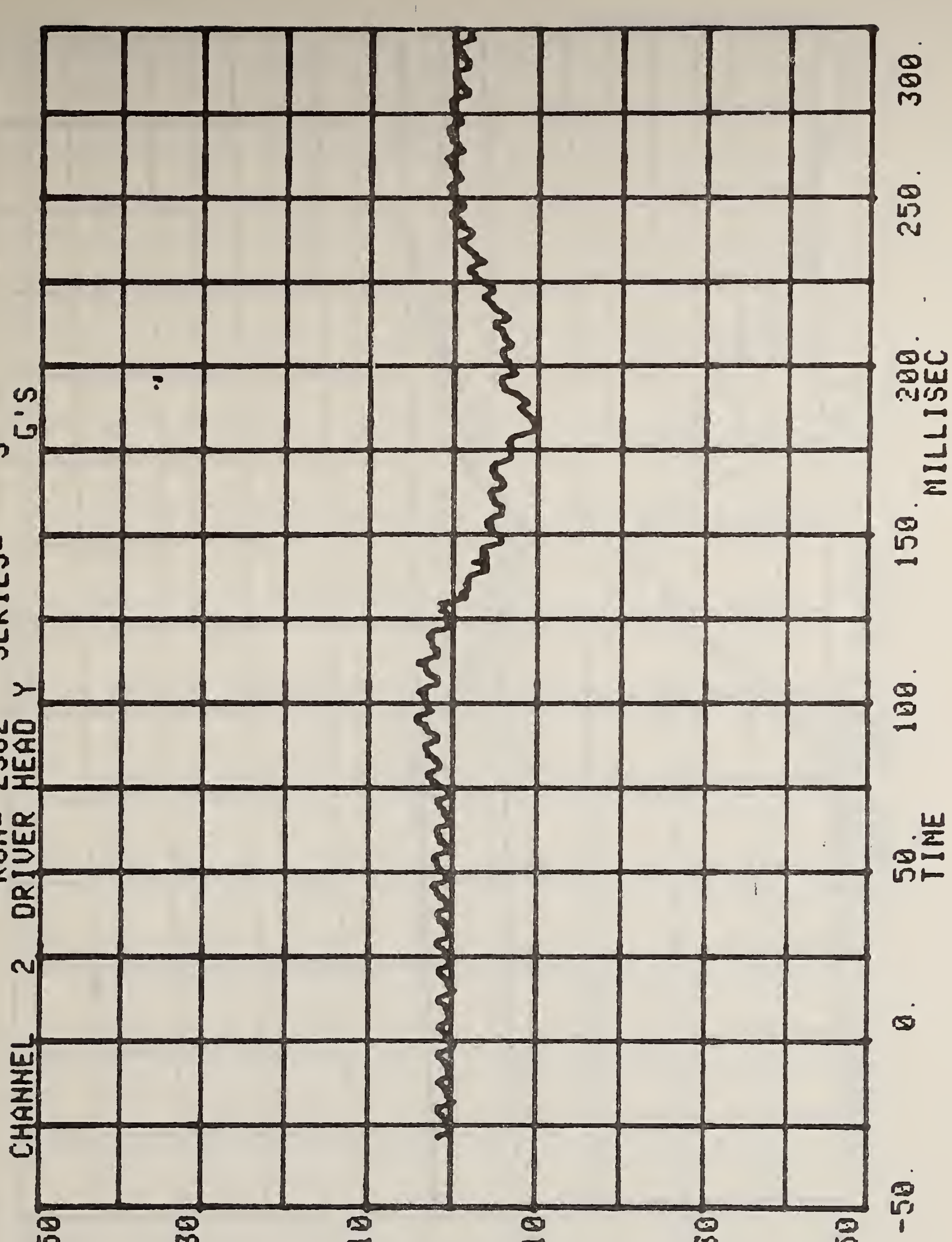
HIC= 35.3 FROM T1= .10800 TO T2= .21120

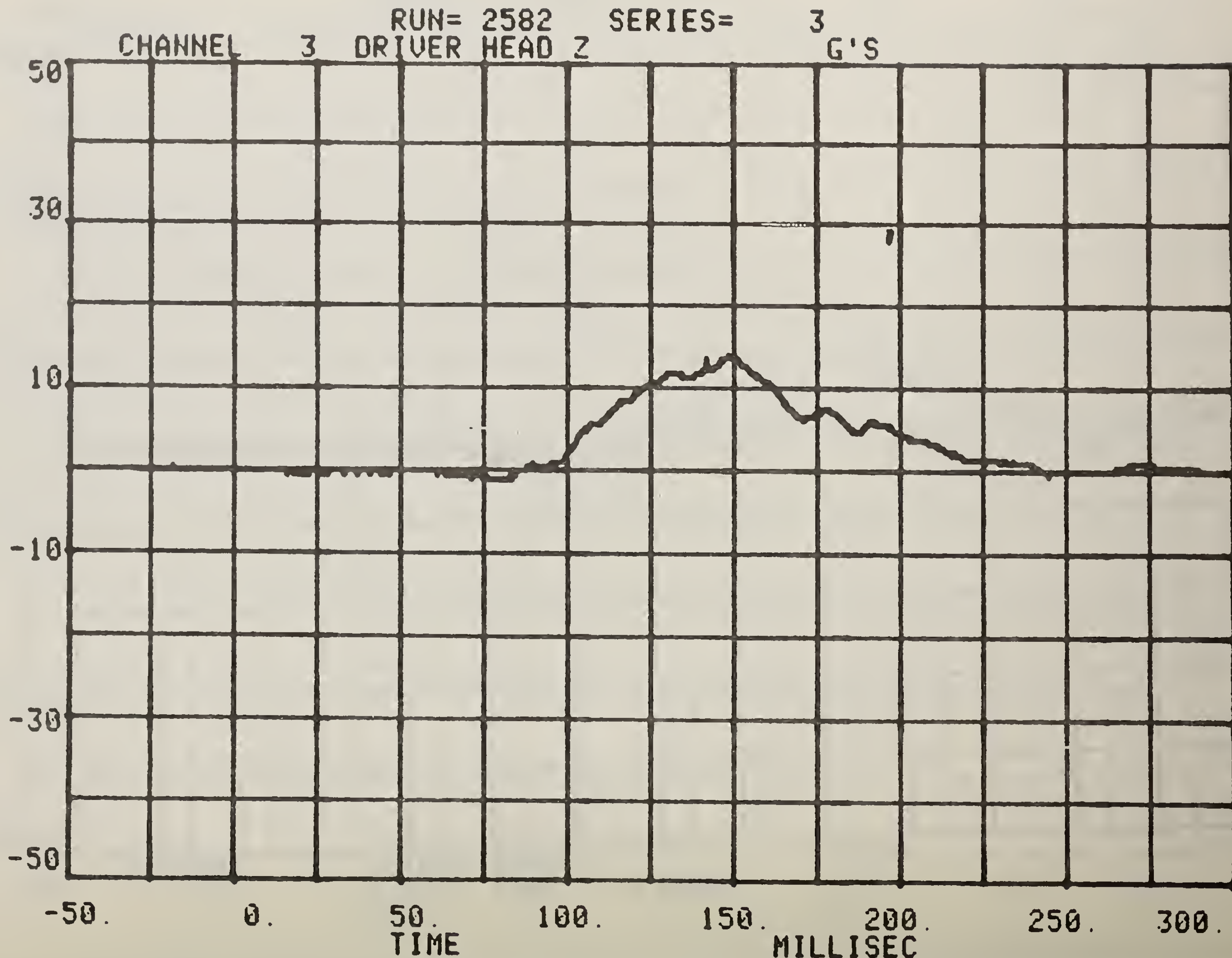
AVERAGE ACCELERATION BETWEEN T1 AND T2= 10.3G'S

EVENT TIME= 300.0 MSEC

SEVERITY INDEX= 41.4


RUN= 2582 SERIES= 3
CHANNEL 1 DRIVER HEAD X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 2 RUN= 2582 SERIES= 3
DRIVER HEAD Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2582 SERIES= 3
CHANNEL 3 DRIVER HEAD Z
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
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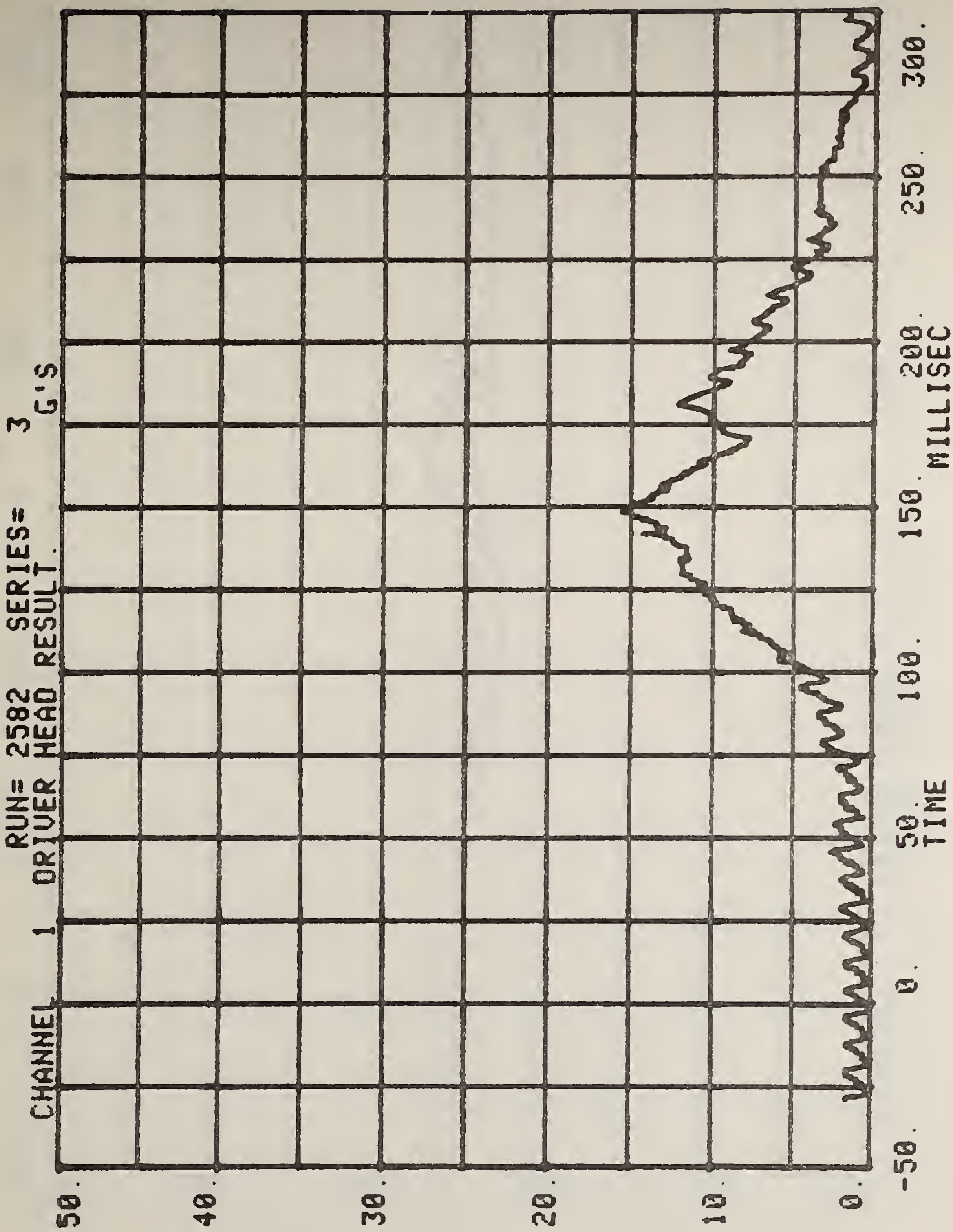
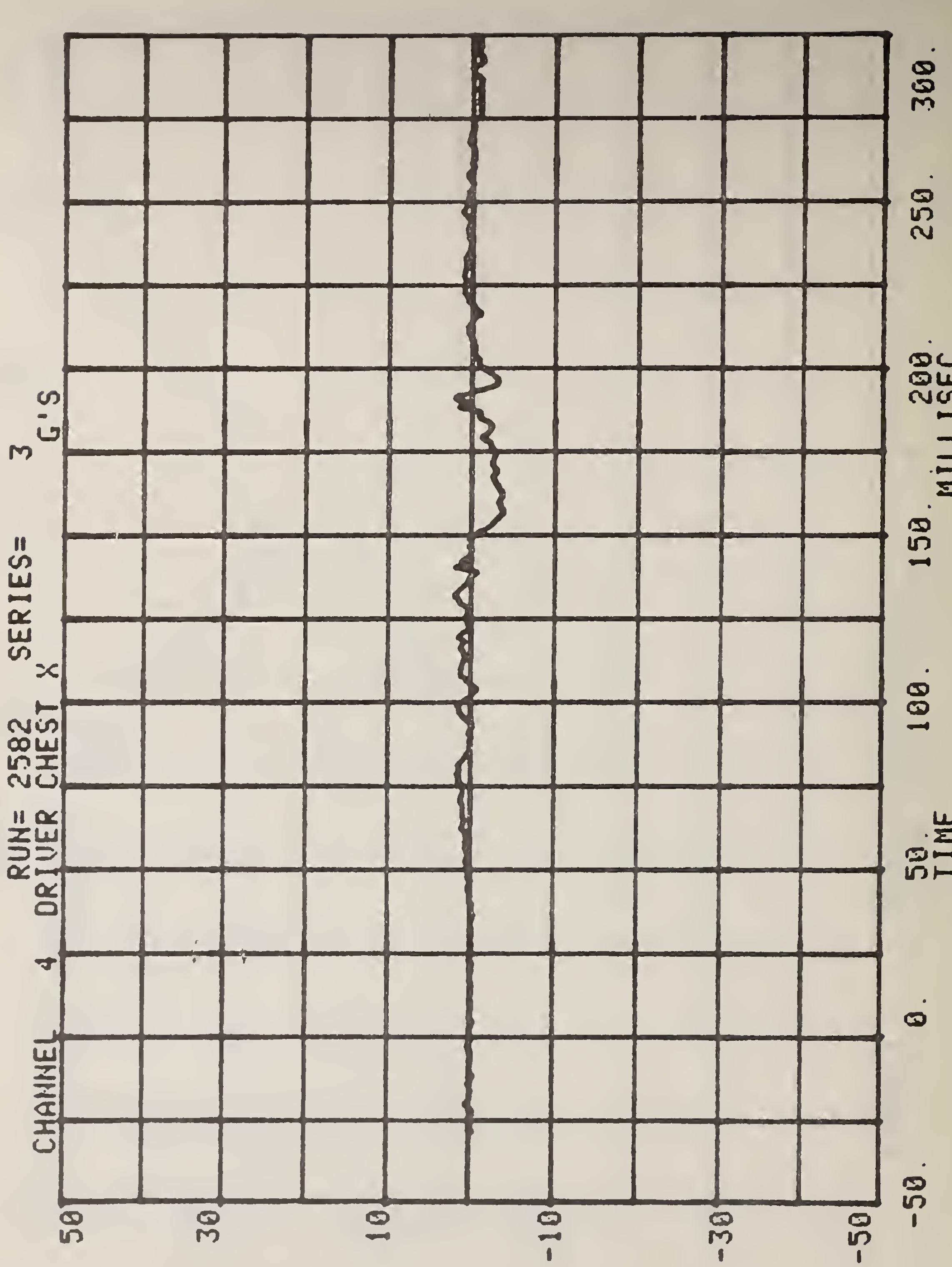
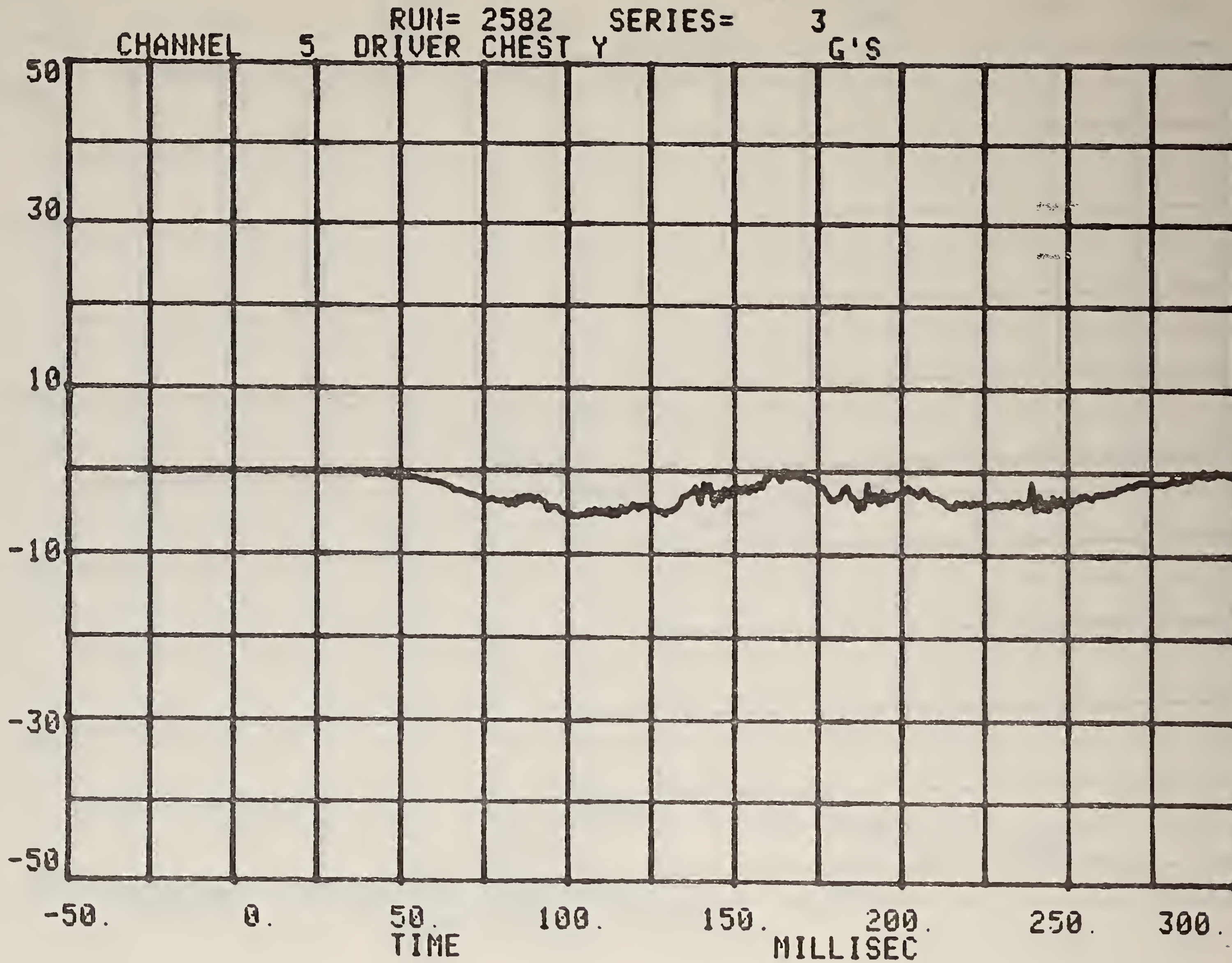
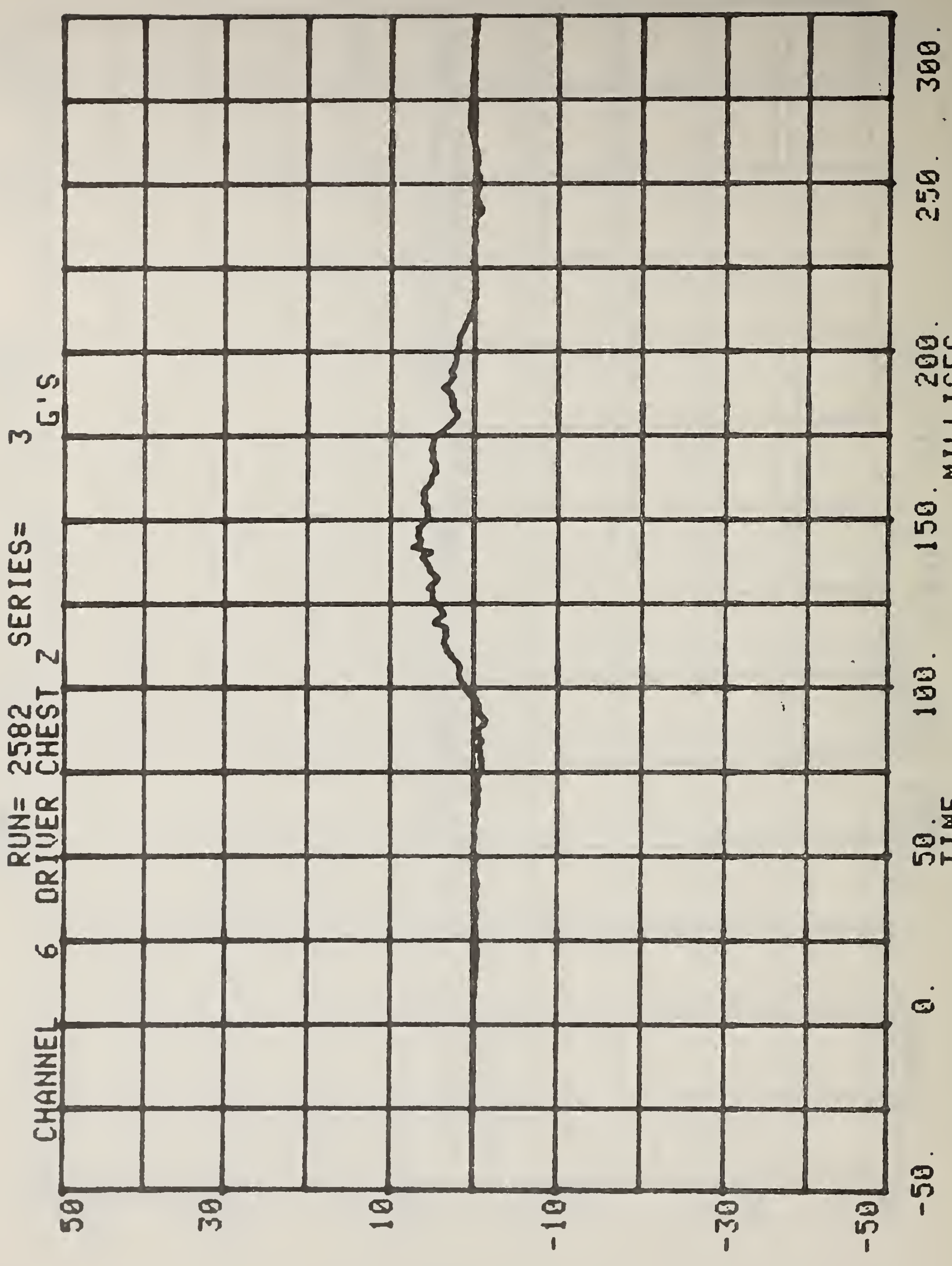
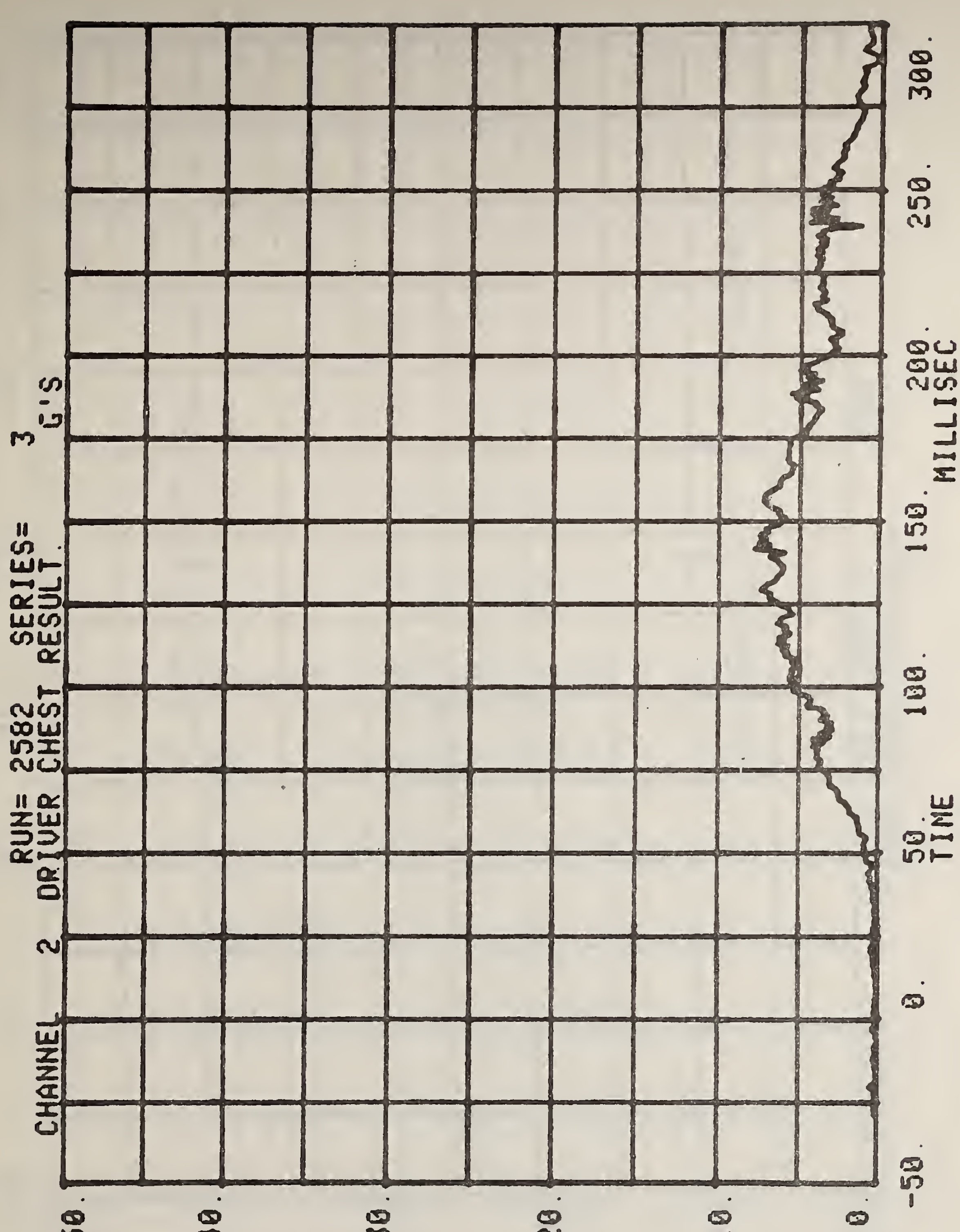
150.
200.
250.
300.
TIME
MILLISEC

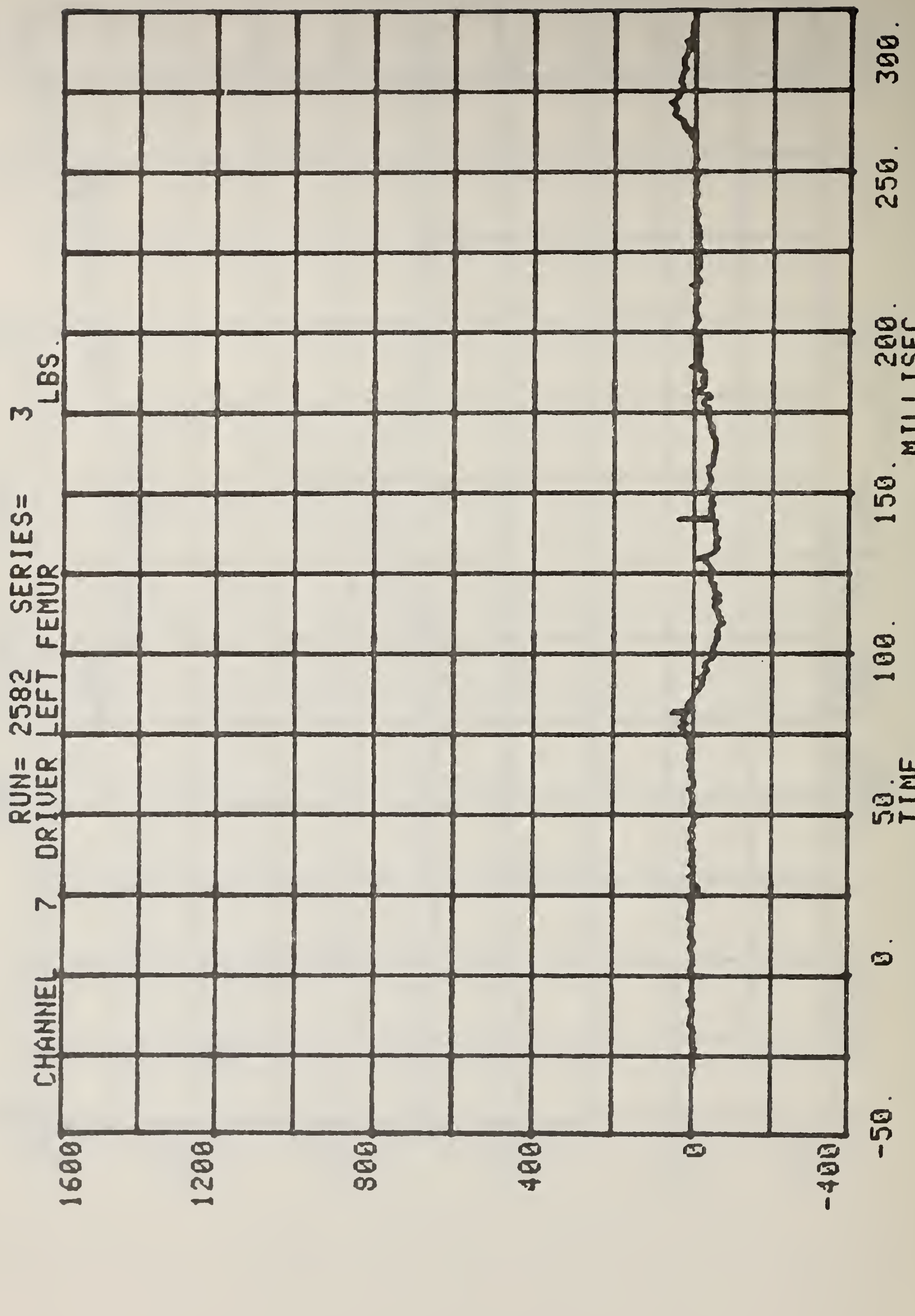

CHANNEL 1 RUN= 2582 SERIES= 3
DRIVER HEAD RESULT. G'S
TIME MILLISEC
-50.
0.
50.
100.
150.
200.
250.
300.
0.
10.
20.
30.
40.
50.


CHANNEL 4 RUN= 2582 SERIES= 3
DRIVER CHEST X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

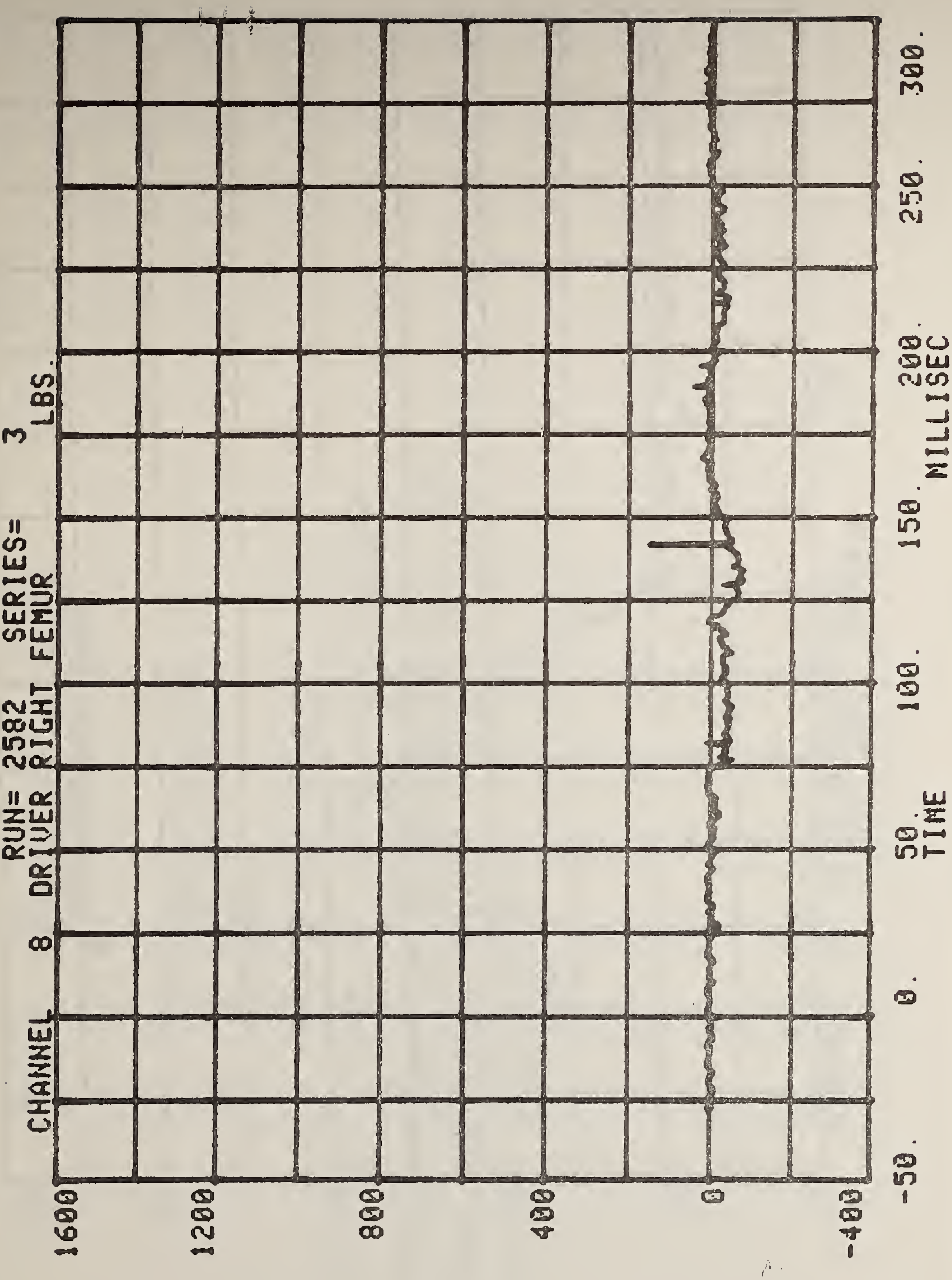

RUN= 2582 SERIES= 3
CHANNEL 5 DRIVER CHEST Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

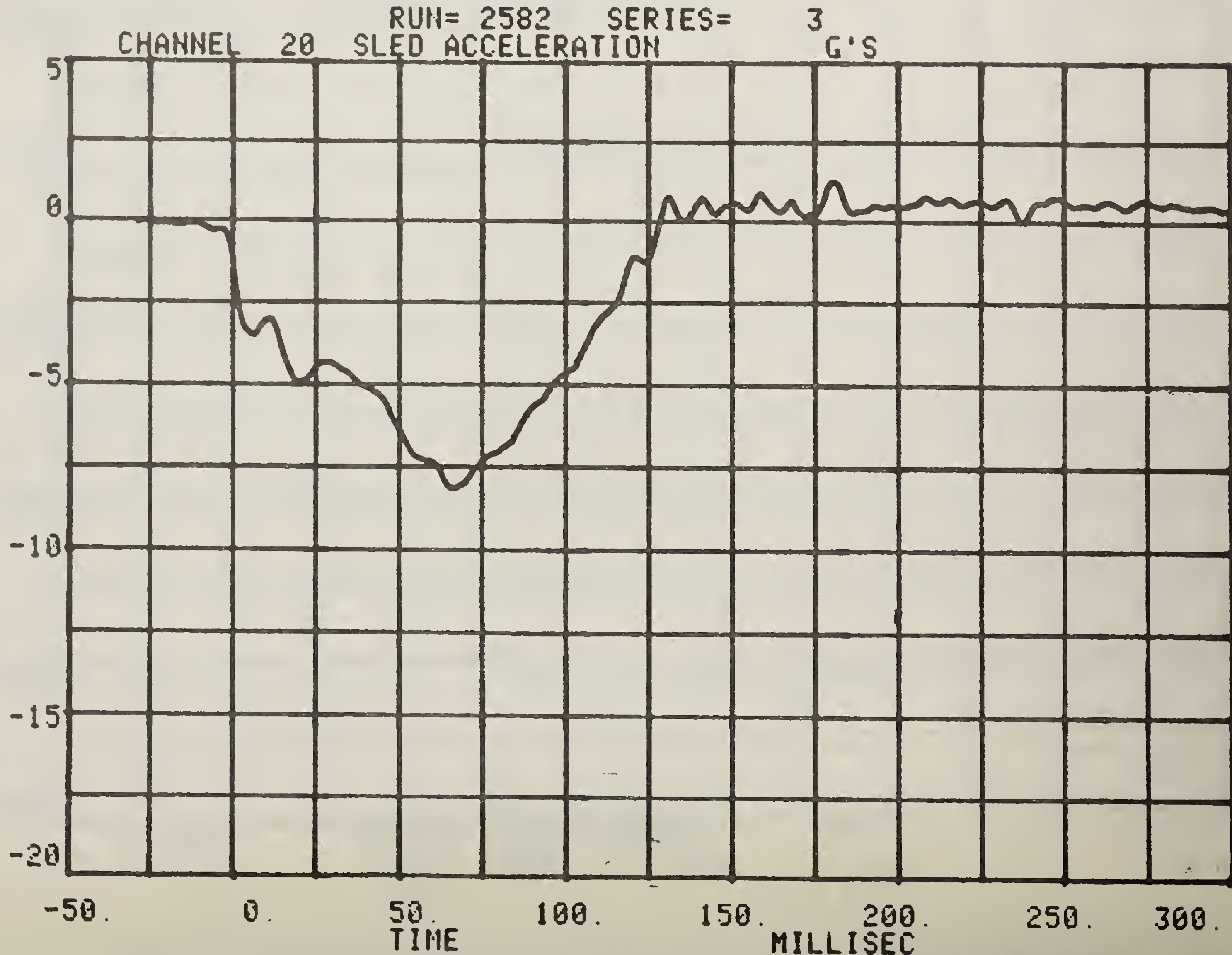

CHANNEL 6 RUN= 2582 SERIES= 3
DRIVER CHEST Z G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 2 RUN= 2582 SERIES= 3
DRIVER CHEST RESULT G'S
TIME MILLISEC
-50. 0. 50. 100. 150. 200. 250. 300.
0. 10. 20. 30. 40. 50.



CHANNEL 7 RUN= 2582 SERIES= 3
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 8 RUN= 2582 SERIES= 3
DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



RUN= 2582 SERIES= 3
CHANNEL 20 SLED ACCELERATION G'S
5
0
-5
-10
-15
-20
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2583

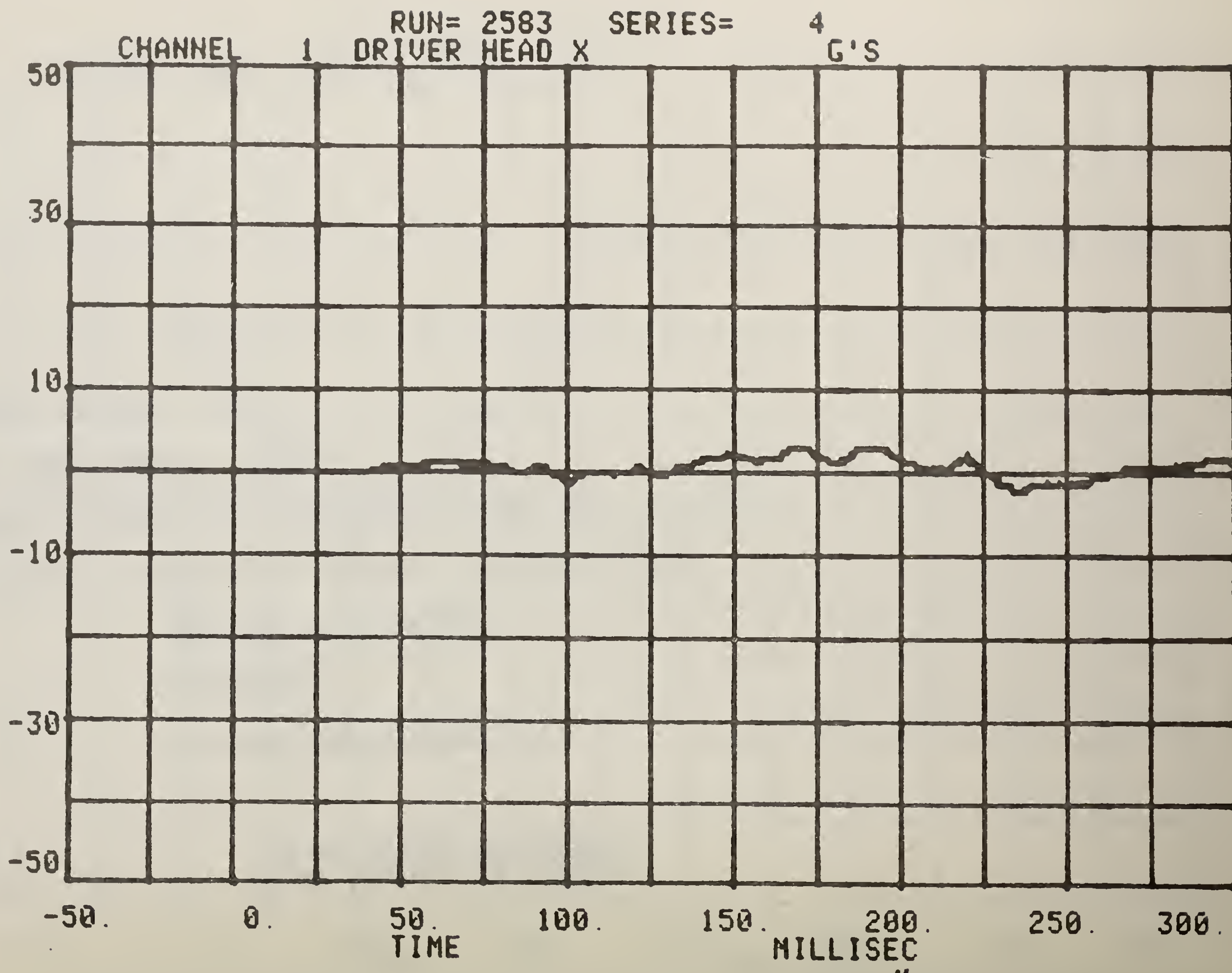
DRIVER HEAD RESULT.

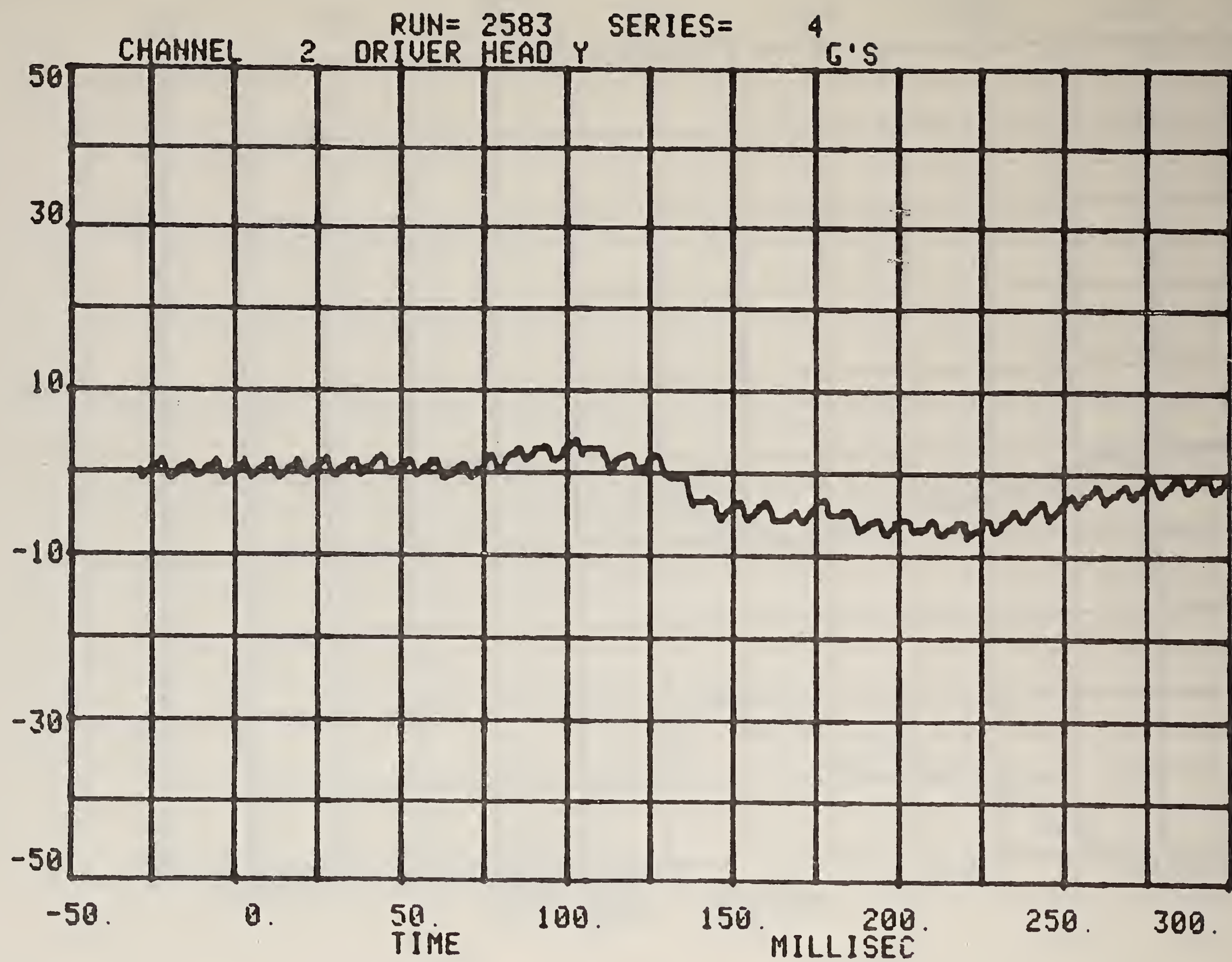
HIC= 30.8 FROM T1= .10740 TO T2= .23940

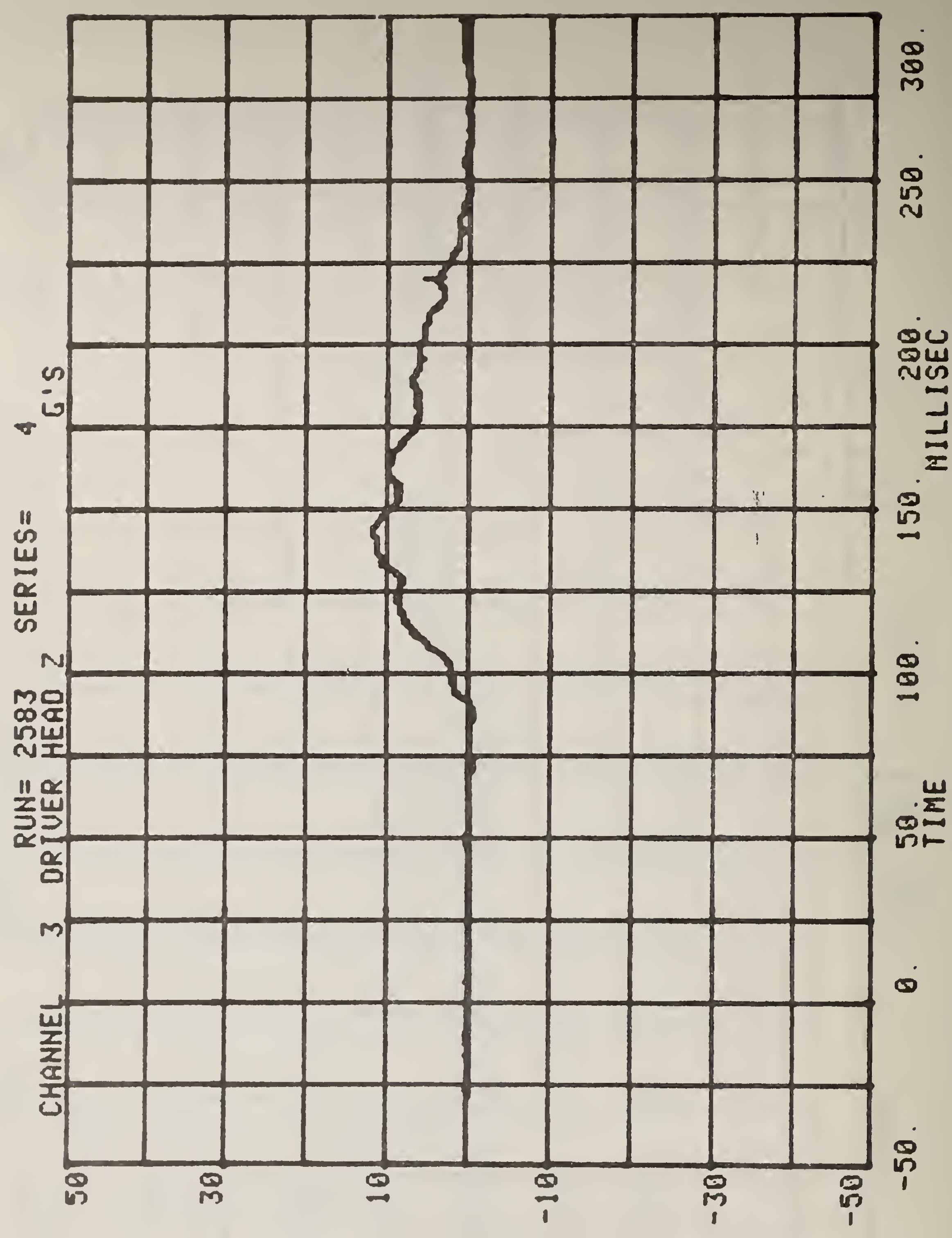
AVERAGE ACCELERATION BETWEEN T1 AND T2= 8.9G'S

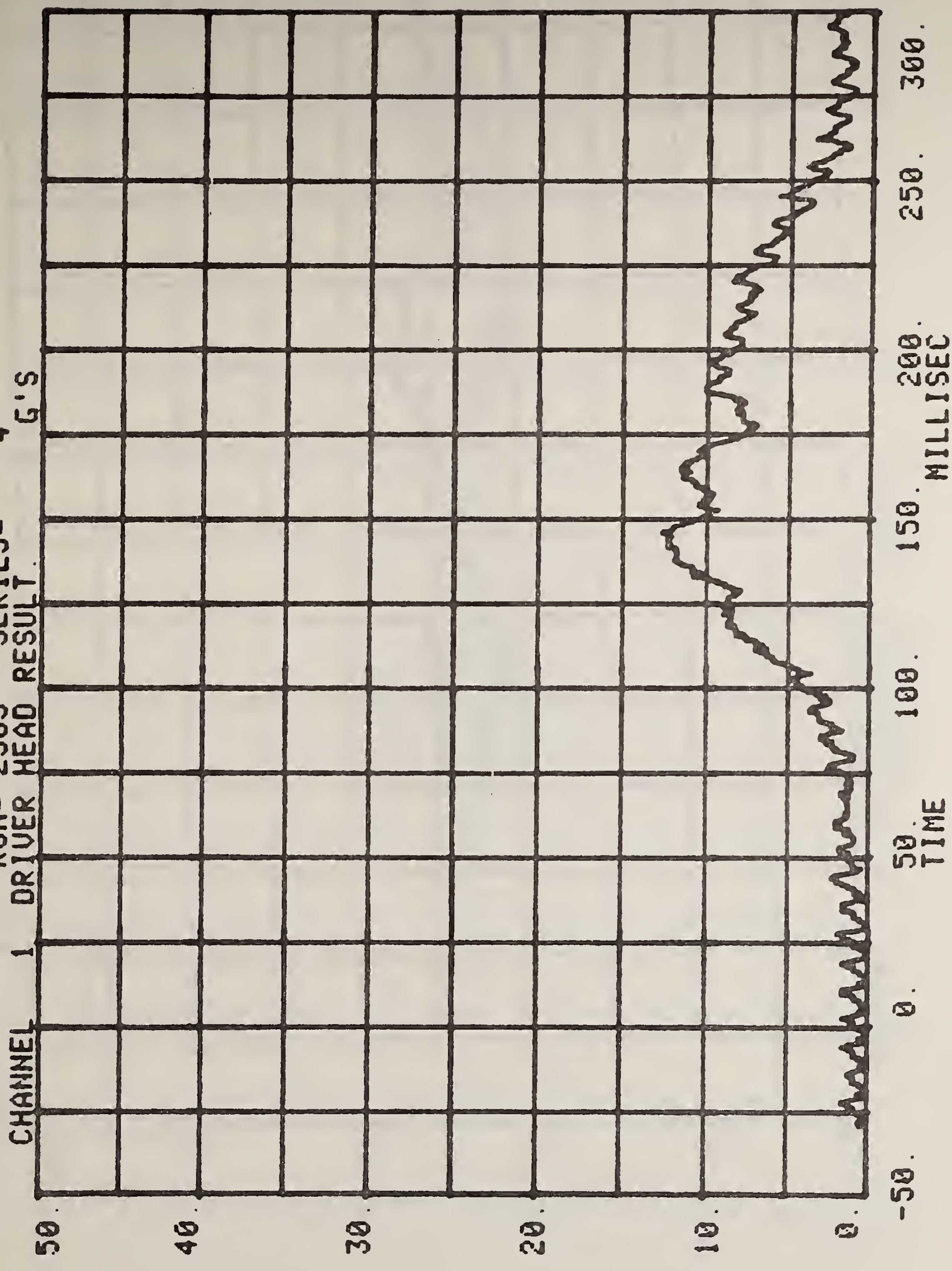
EVENT TIME= 300.0 MSEC

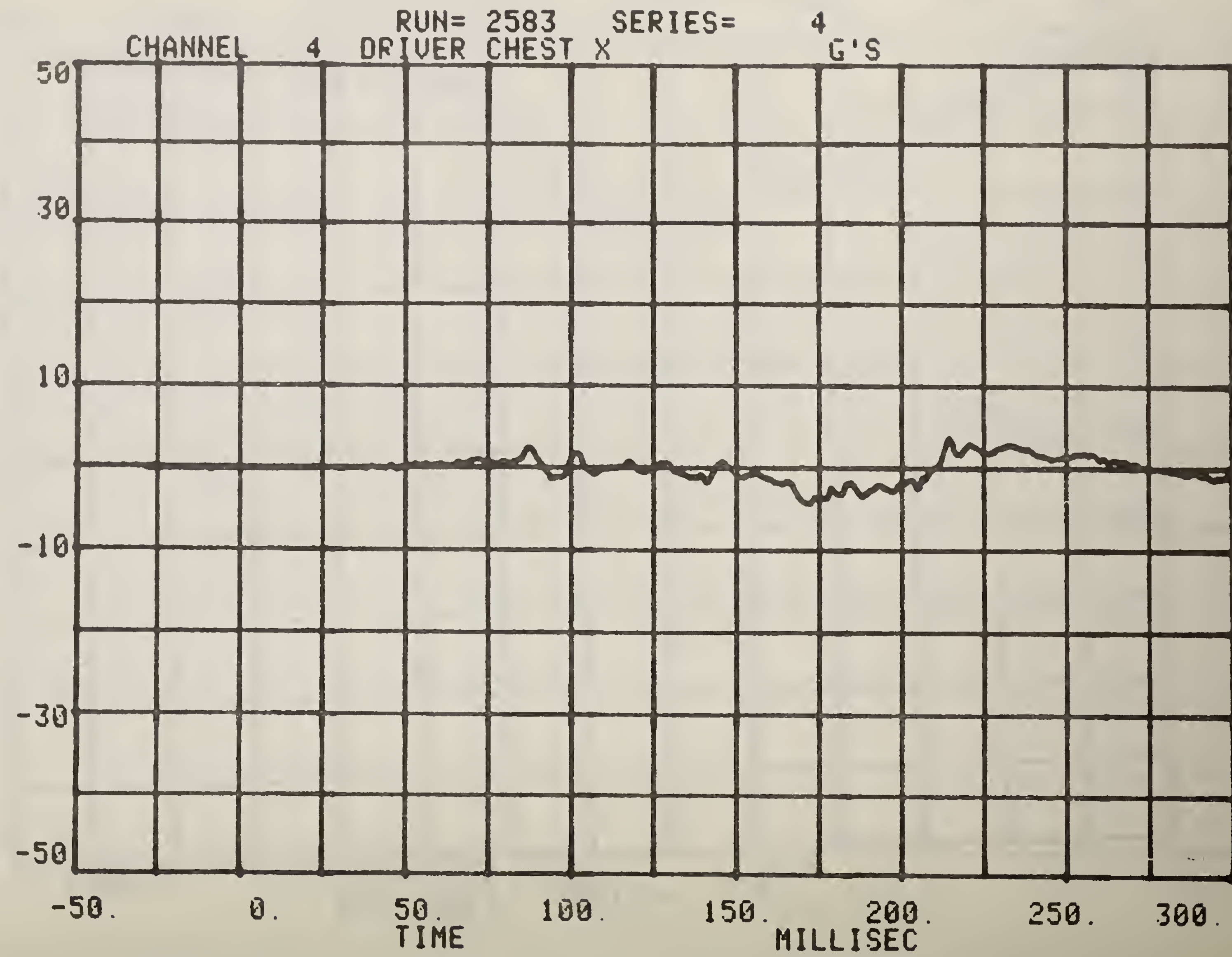
SEVERITY INDEX= 34.8

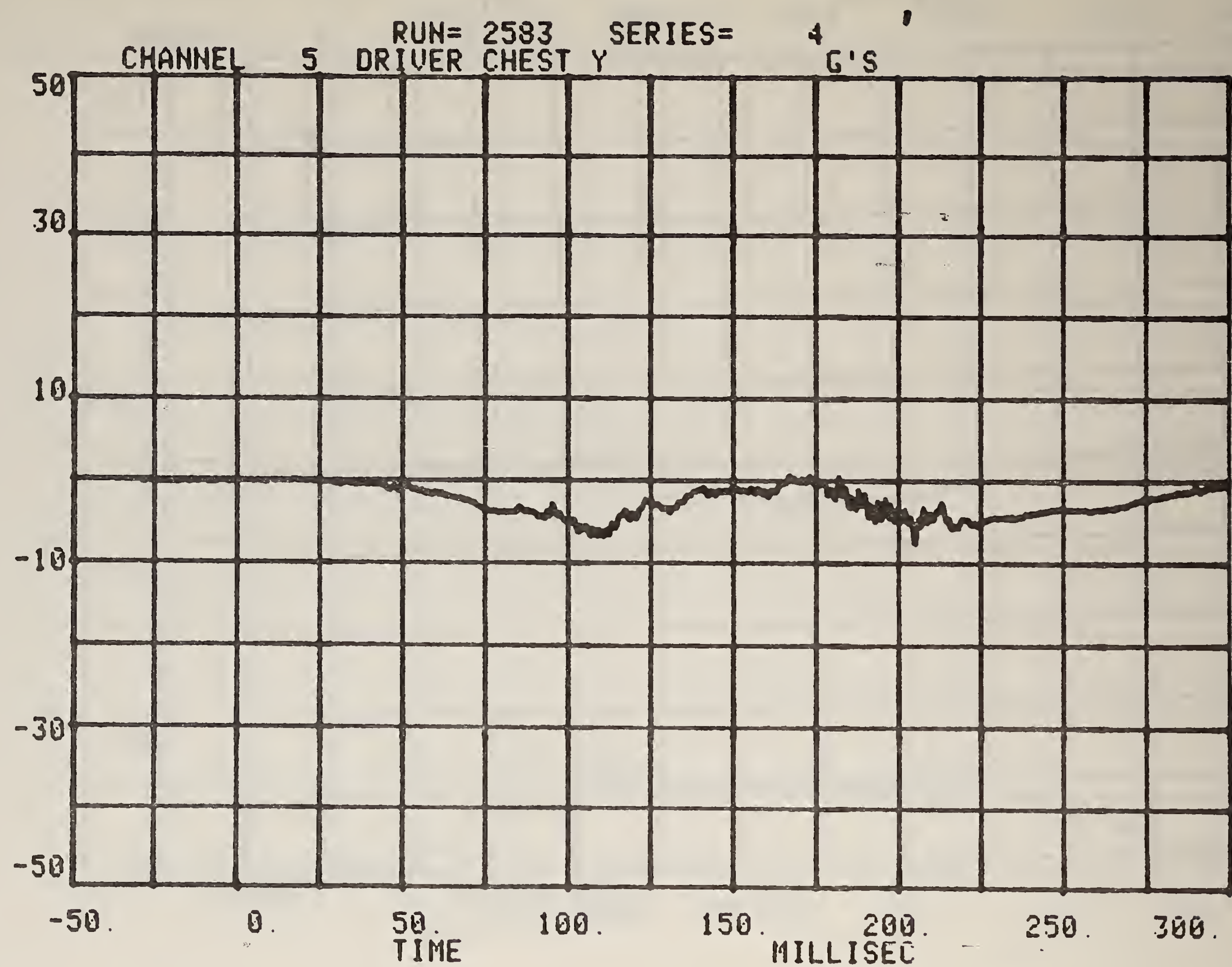

RUN= 2583 SERIES= 4
CHANNEL 1 DRIVER HEAD X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

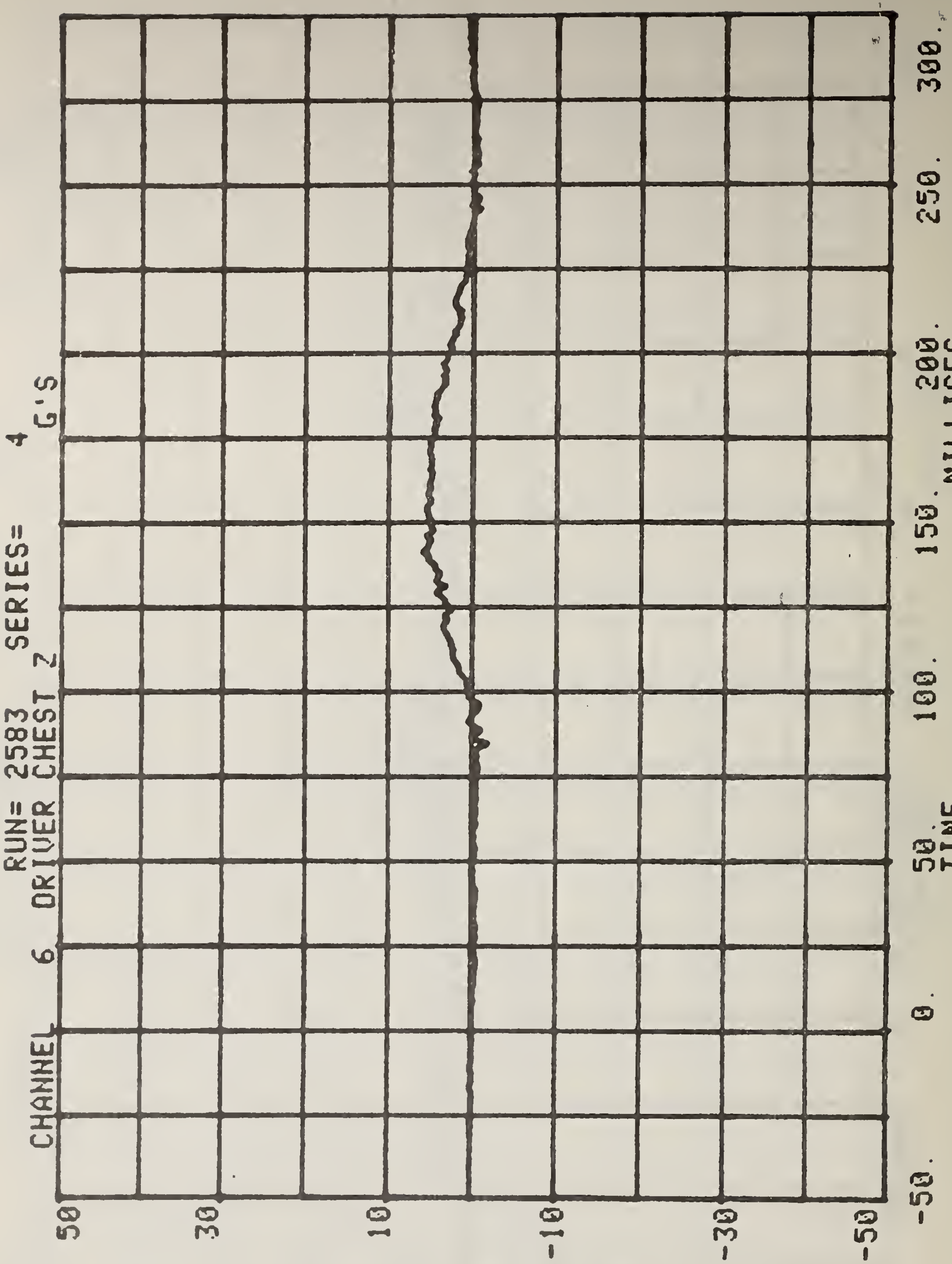

RUN= 2583 SERIES= 4
CHANNEL 2 DRIVER HEAD Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

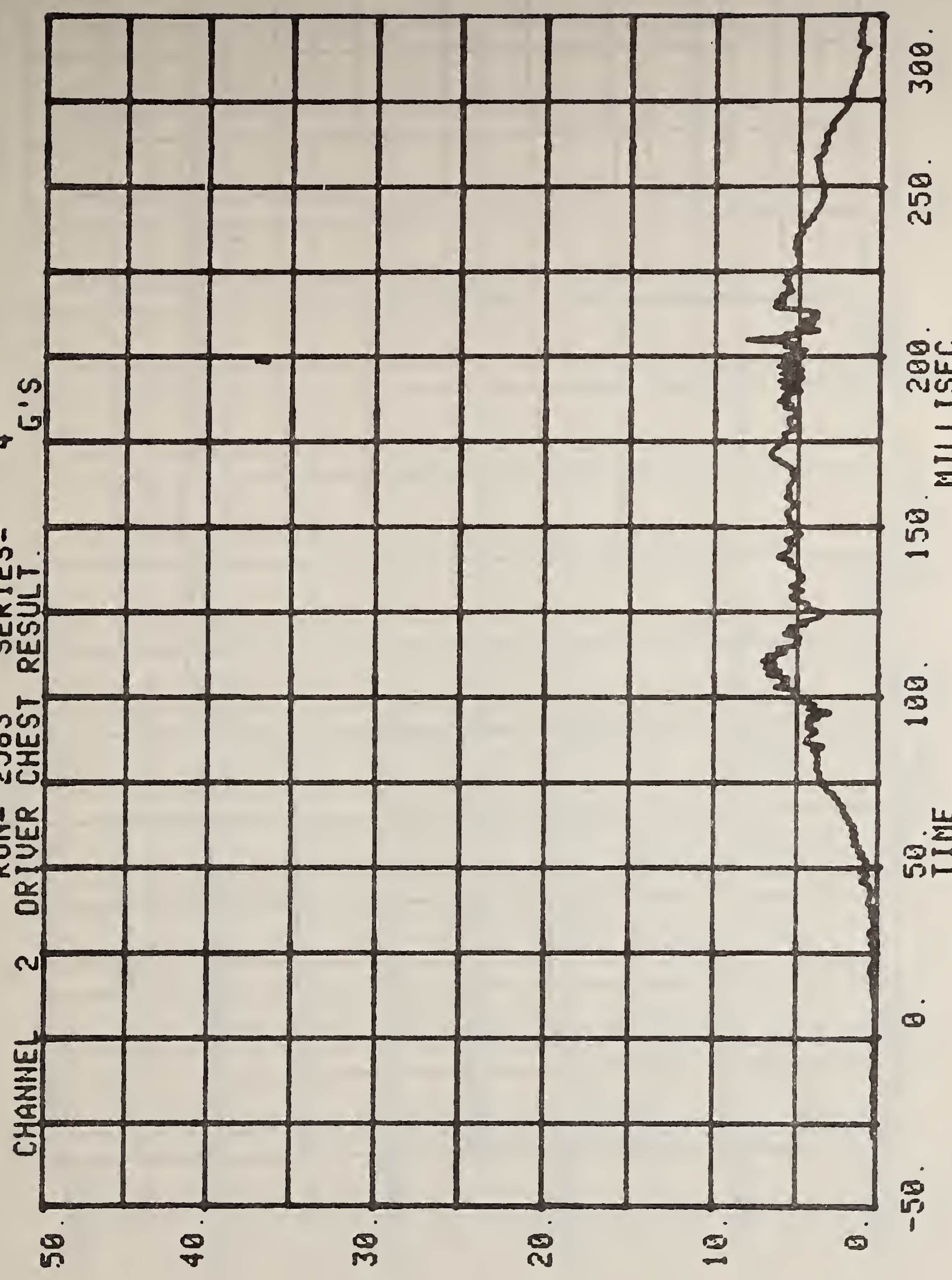

CHANNEL 3 RUN= 2583 SERIES= 4
DRIVER HEAD Z G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

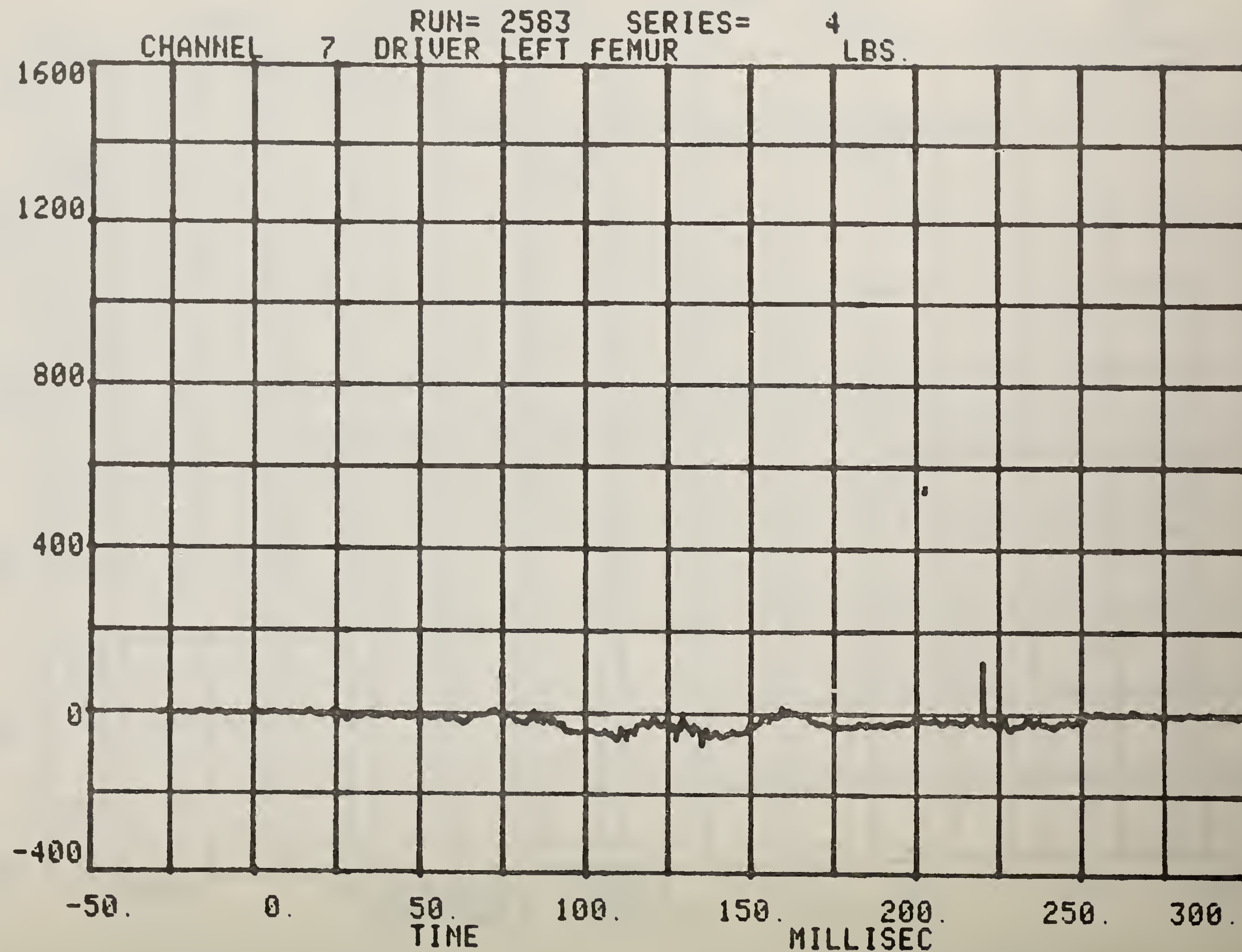

CHANNEL 1 RUN= 2583 SERIES= 4
DRIVER HEAD RESULT G'S
TIME MILLISEC
-50.
0.
50.
100.
150.
200.
250.
300.
0.
10.
20.
30.
40.
50.

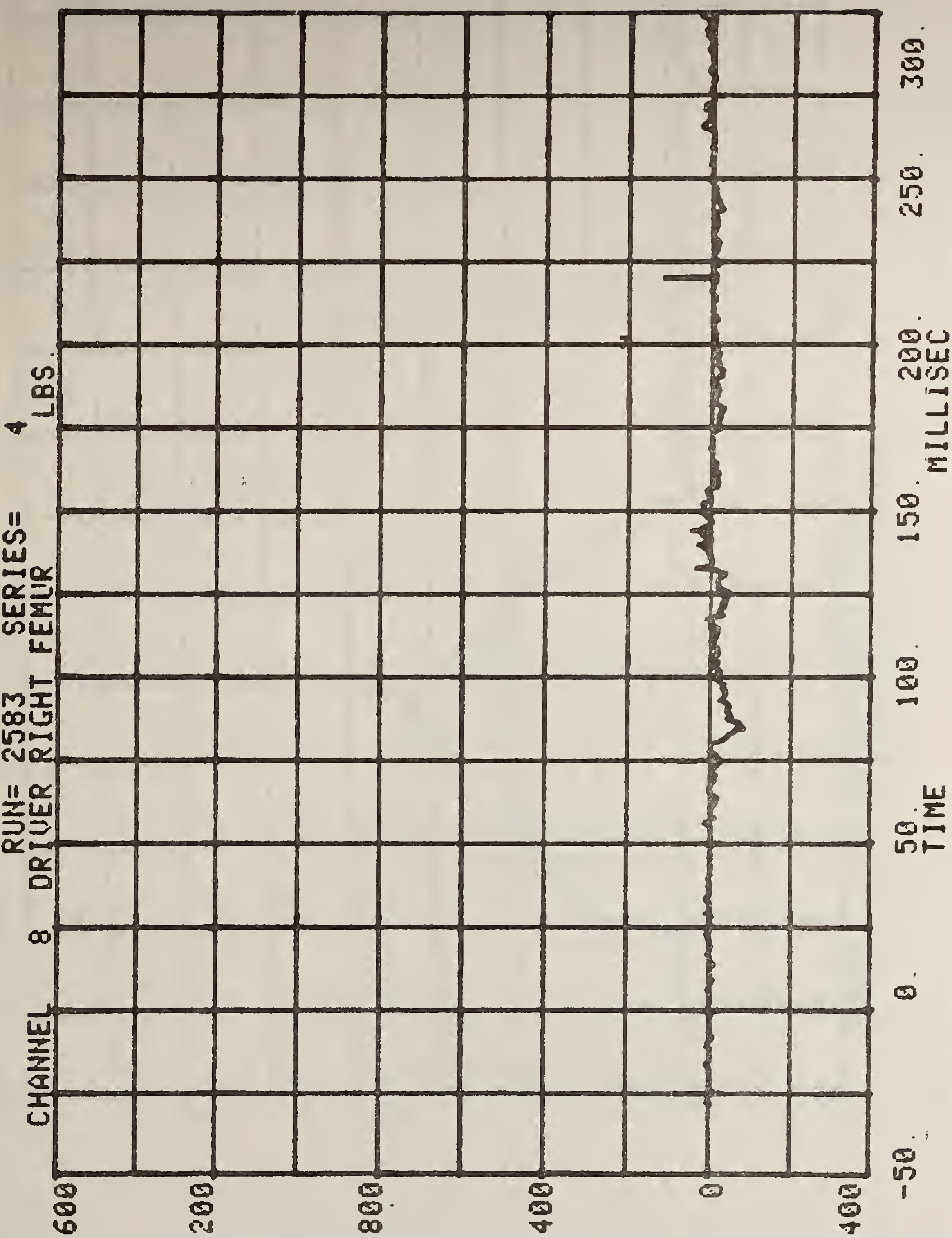

RUN= 2583 SERIES= 4
CHANNEL 4 DRIVER CHEST X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

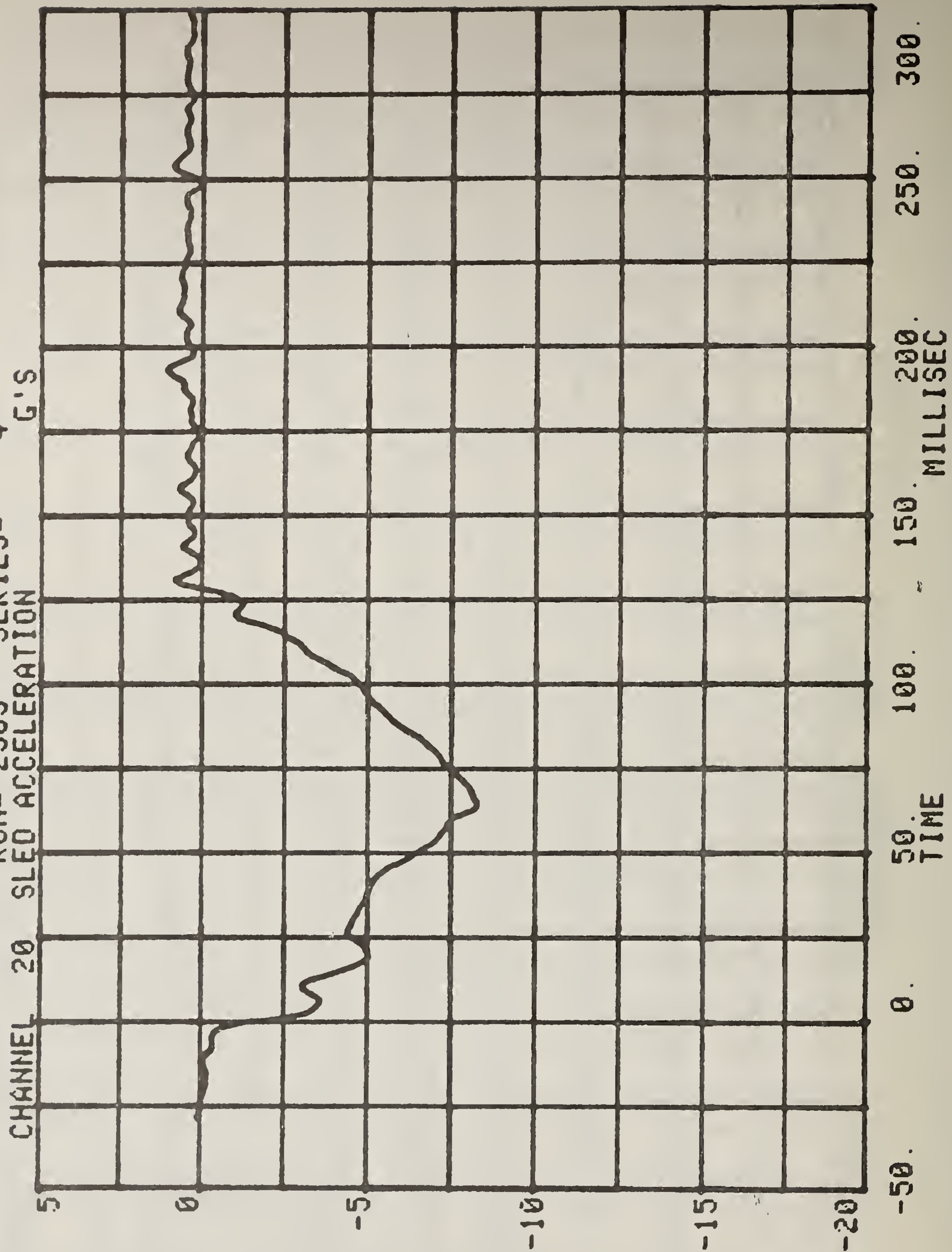

RUN= 2583 SERIES= 4
CHANNEL 5 DRIVER CHEST Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 6 RUN= 2583 SERIES= 4
DRIVER CHEST Z G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 2 RUN= 2583 SERIES= 4
DRIVER CHEST RESULT G'S
TIME MILLISEC
-50. 0. 50. 100. 150. 200. 250. 300.
0. 10. 20. 30. 40. 50.


RUN= 2583 SERIES= 4
CHANNEL 7 DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 8 RUN= 2583 SERIES= 4
DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 20 RUN= 2583 SERIES= 4
SLED ACCELERATION G'S
5
0
-5
-10
-15
-20
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

APPENDIX B

30 DEGREE OBLIQUE ANGLE IMPACT SLED TEST DATA RECORDS SLED RUN NOS. 2589-2591

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Femur Loads	600
Sled Acceleration	60

Sequence of Data Records

Driver

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Femur Load - Left, Right

Passenger

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Femur Load - Left, Right

Sled Acceleration

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2589

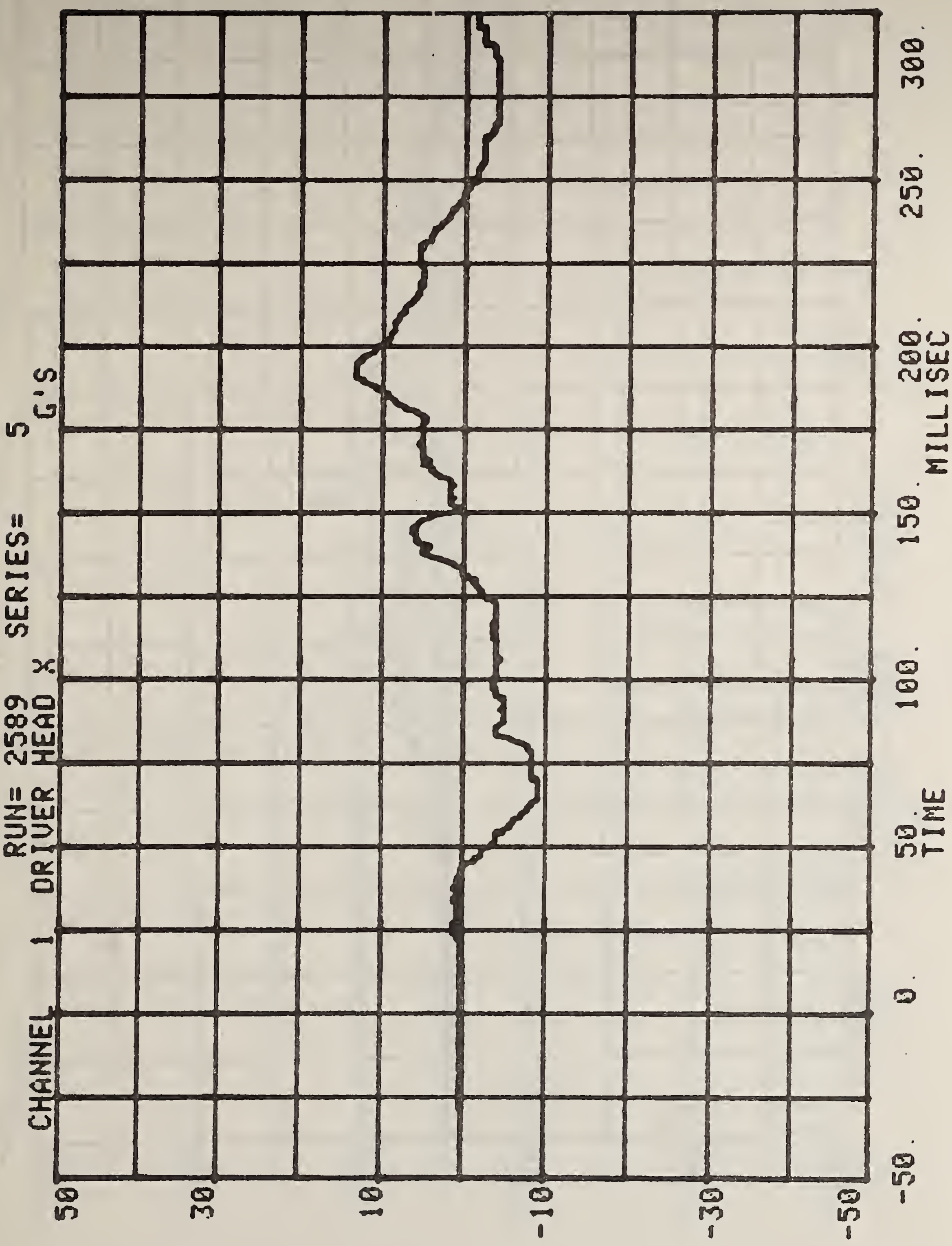
DRIVER HEAD RESULT.

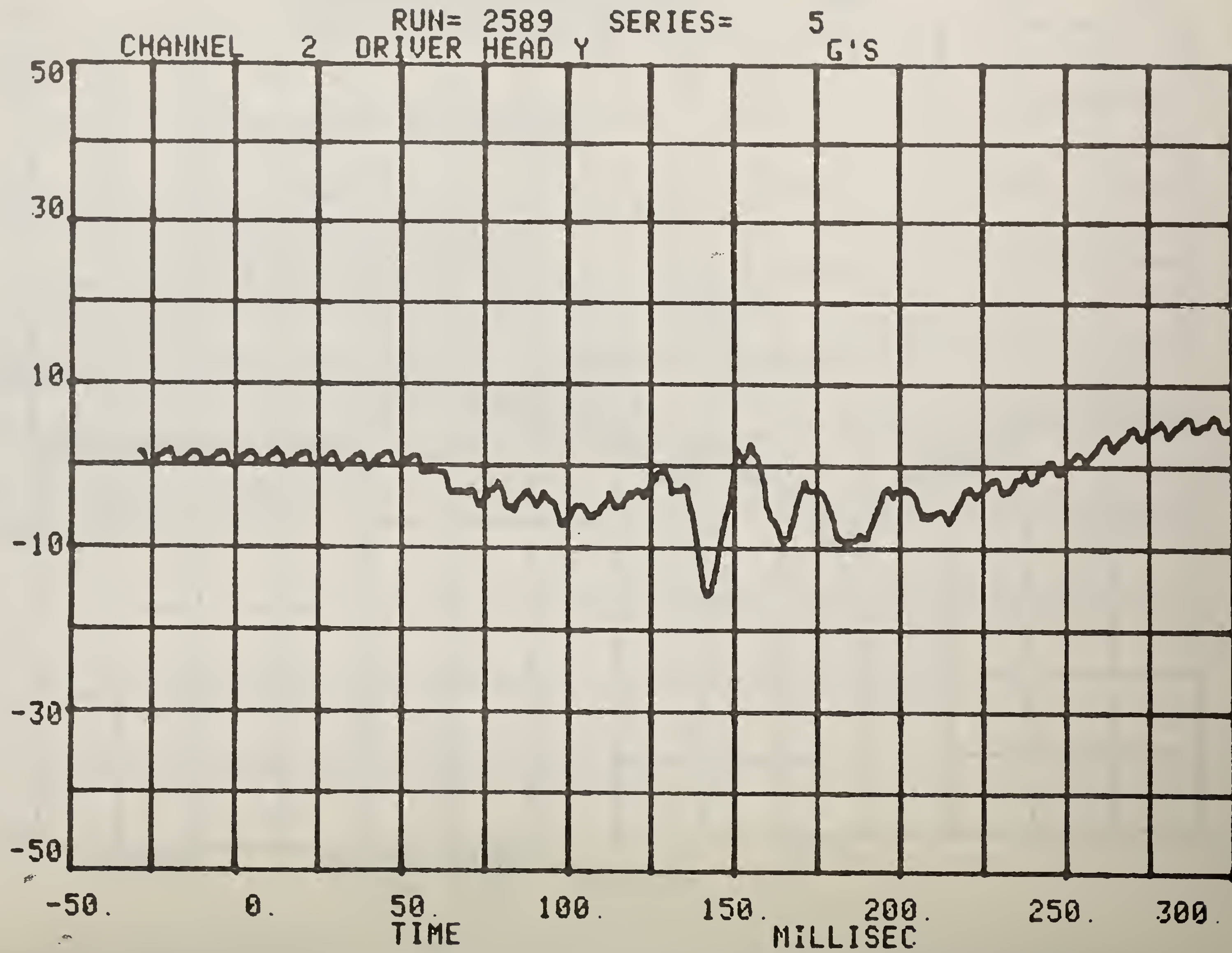
HIC= 117.4   FROM T1= .05970   TO T2= .21600

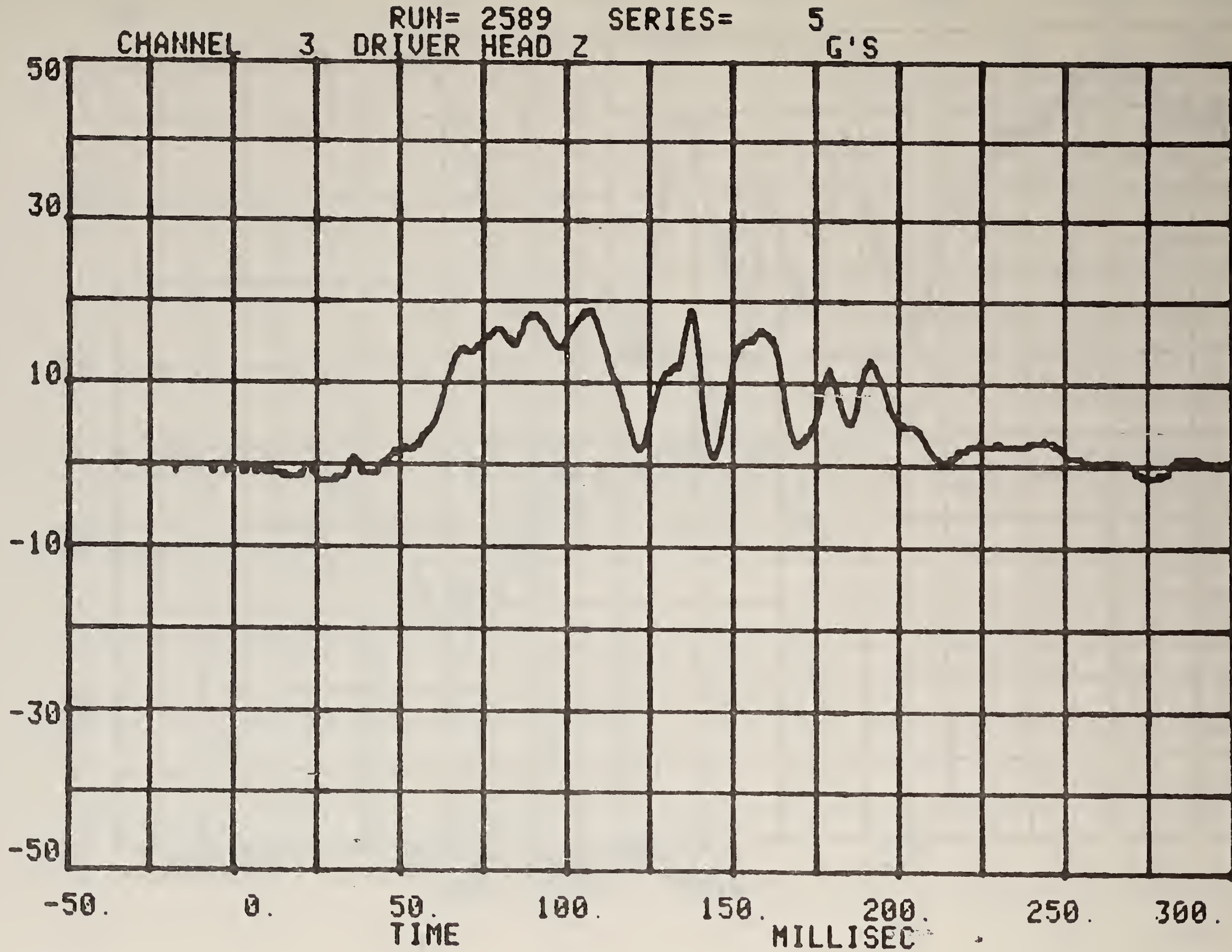
AVERAGE ACCELERATION BETWEEN T1 AND T2= 14.1G'S

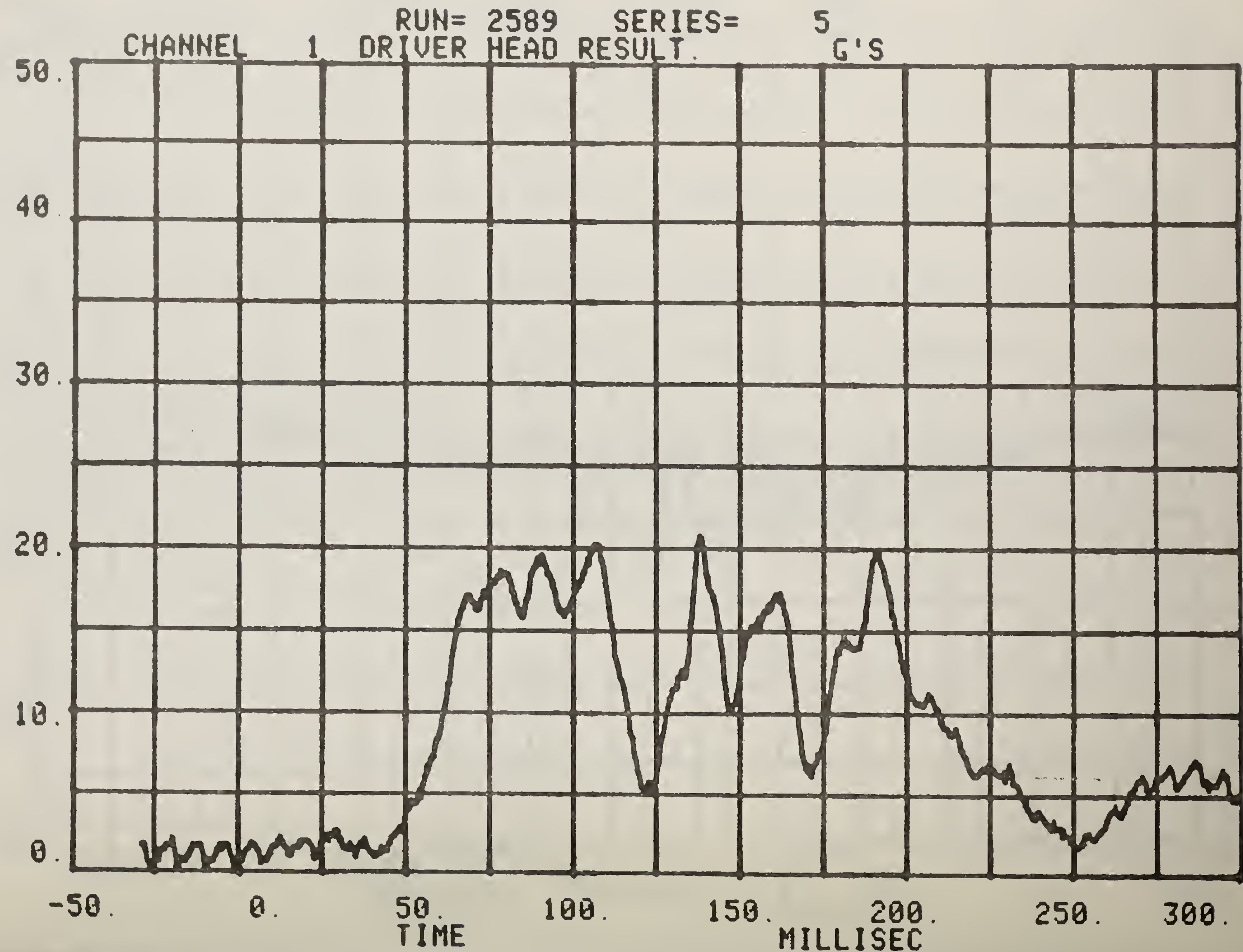
EVENT TIME= 300.0 MSEC

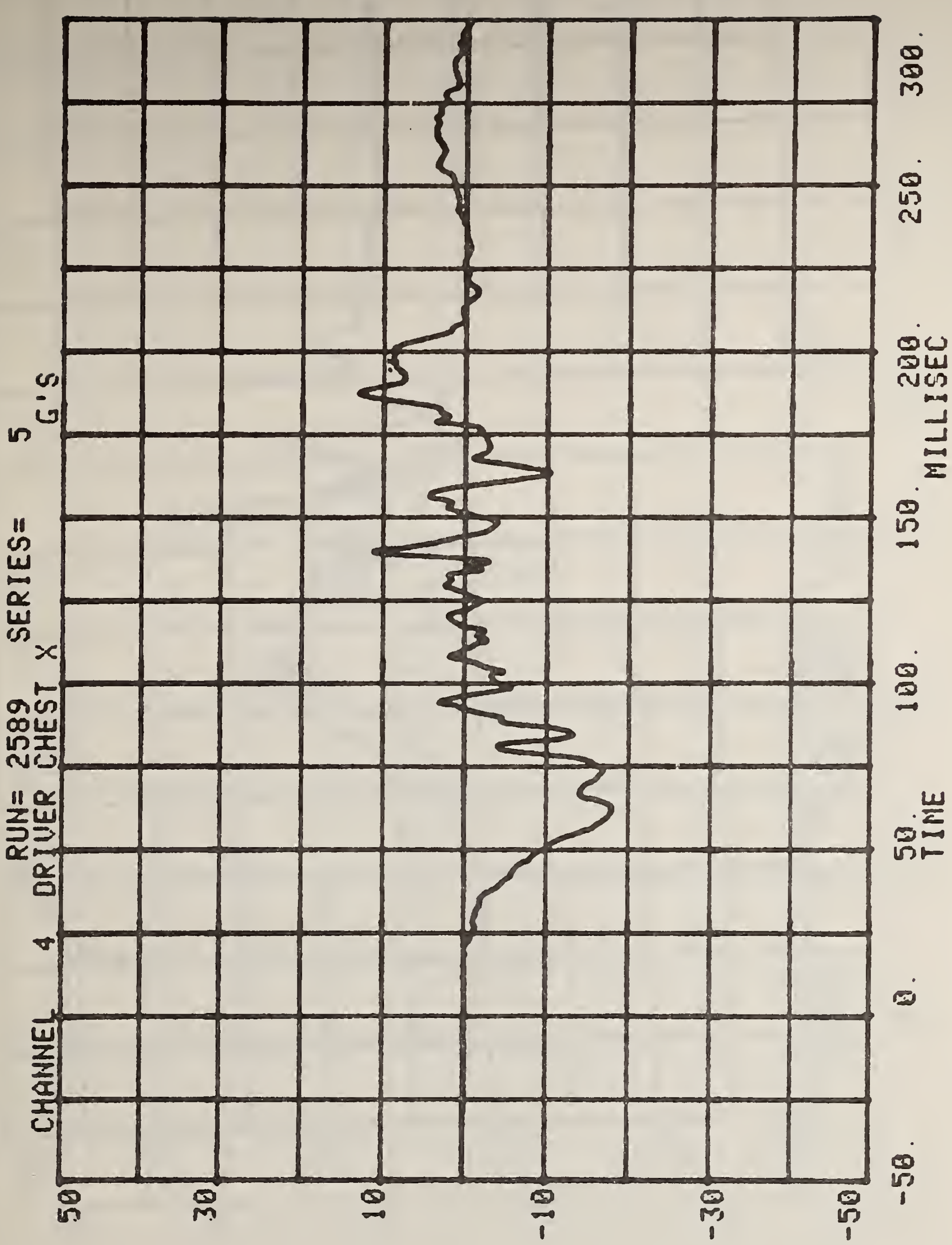
SEVERITY INDEX= 140.9

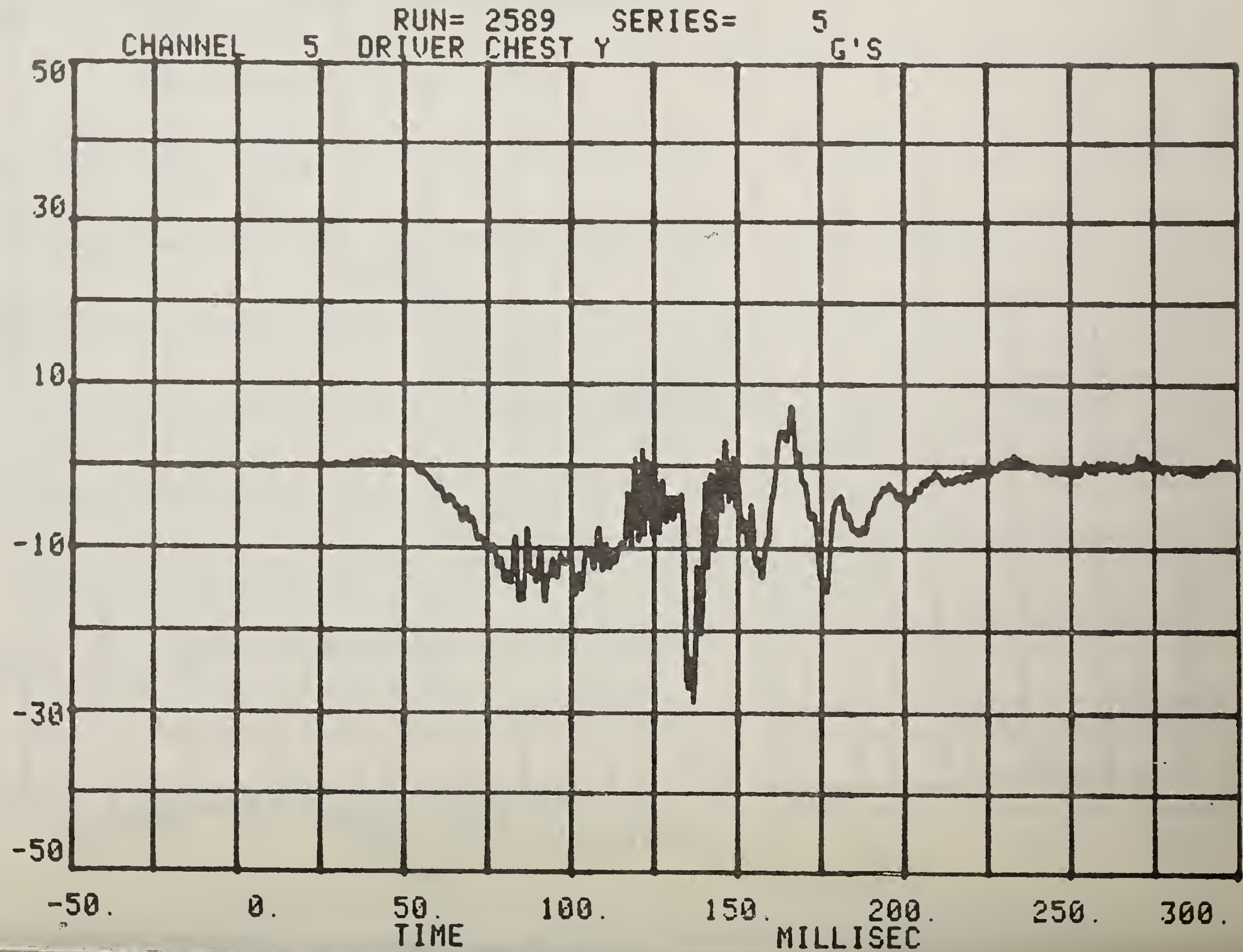

CHANNEL 1 RUN= 2589 SERIES= 5
DRIVER HEAD X G'S
TIME MILLISEC
-50. 0. 50. 100. 150. 200. 250. 300.
50 30 10 -10 -30 -50

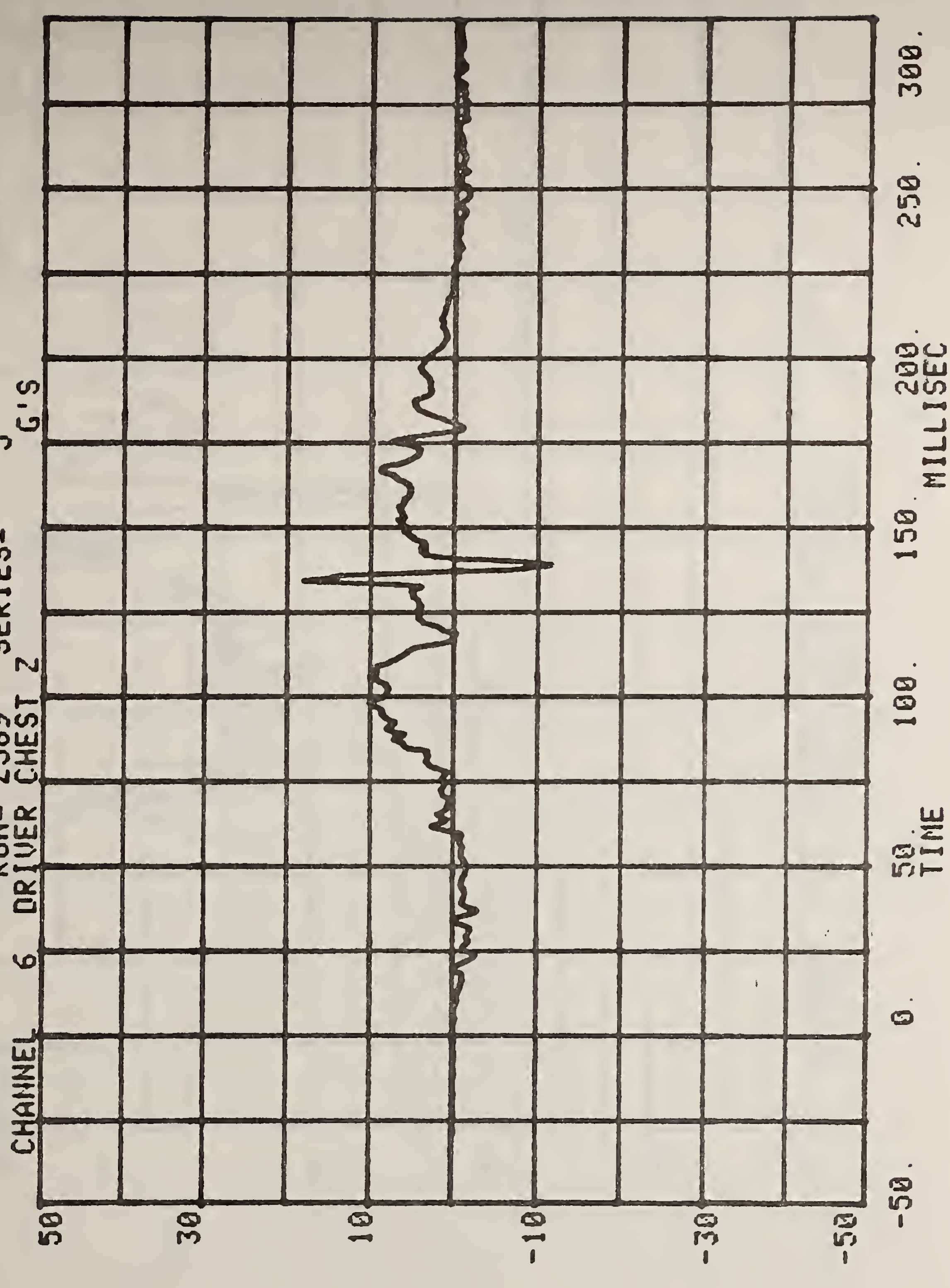

RUN= 2589 SERIES= 5
CHANNEL 2 DRIVER HEAD Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

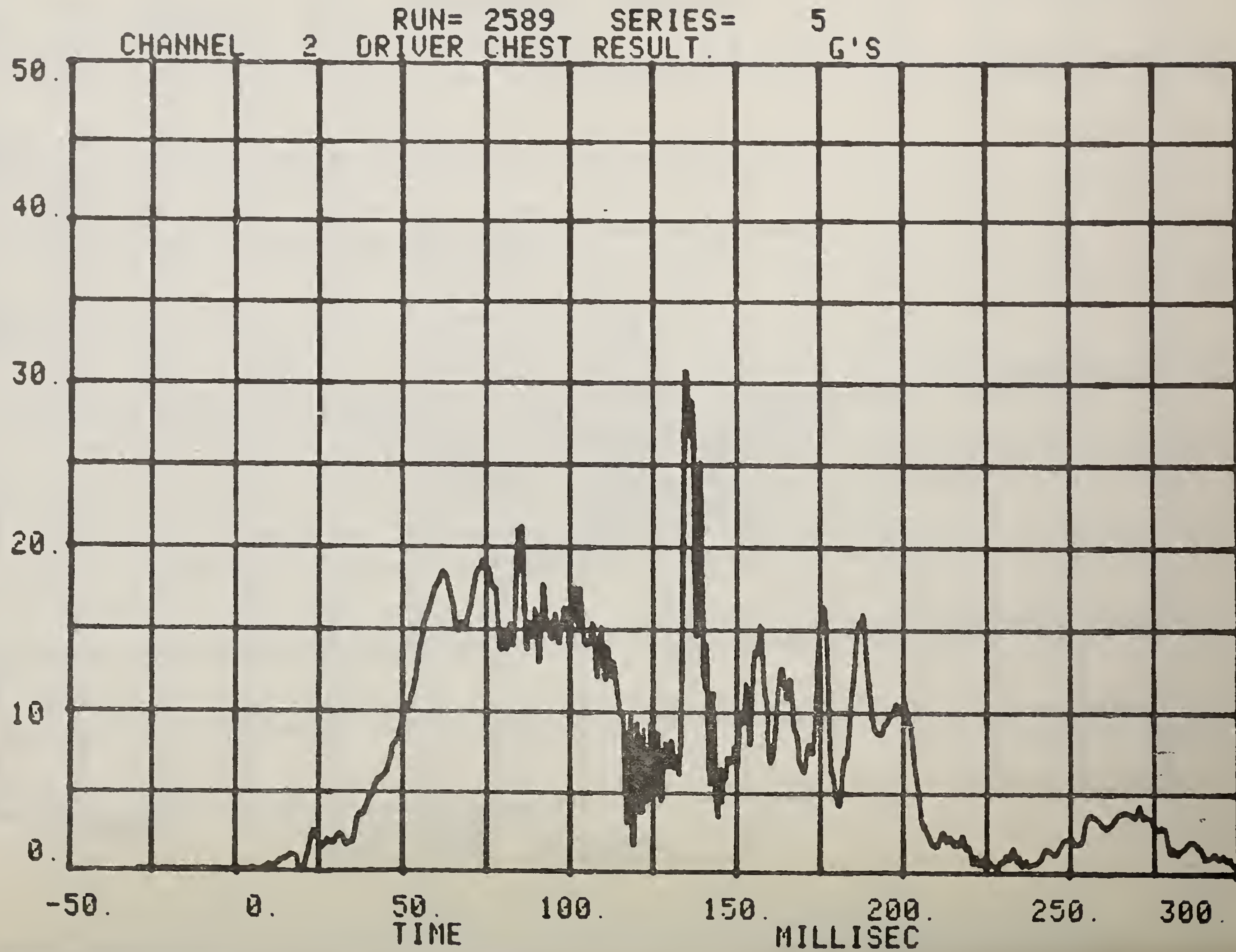

RUN= 2589 SERIES= 5
CHANNEL 3 DRIVER HEAD Z
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2589 SERIES= 5
CHANNEL 1 DRIVER HEAD RESULT. G'S
50.
40.
30.
20.
10.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

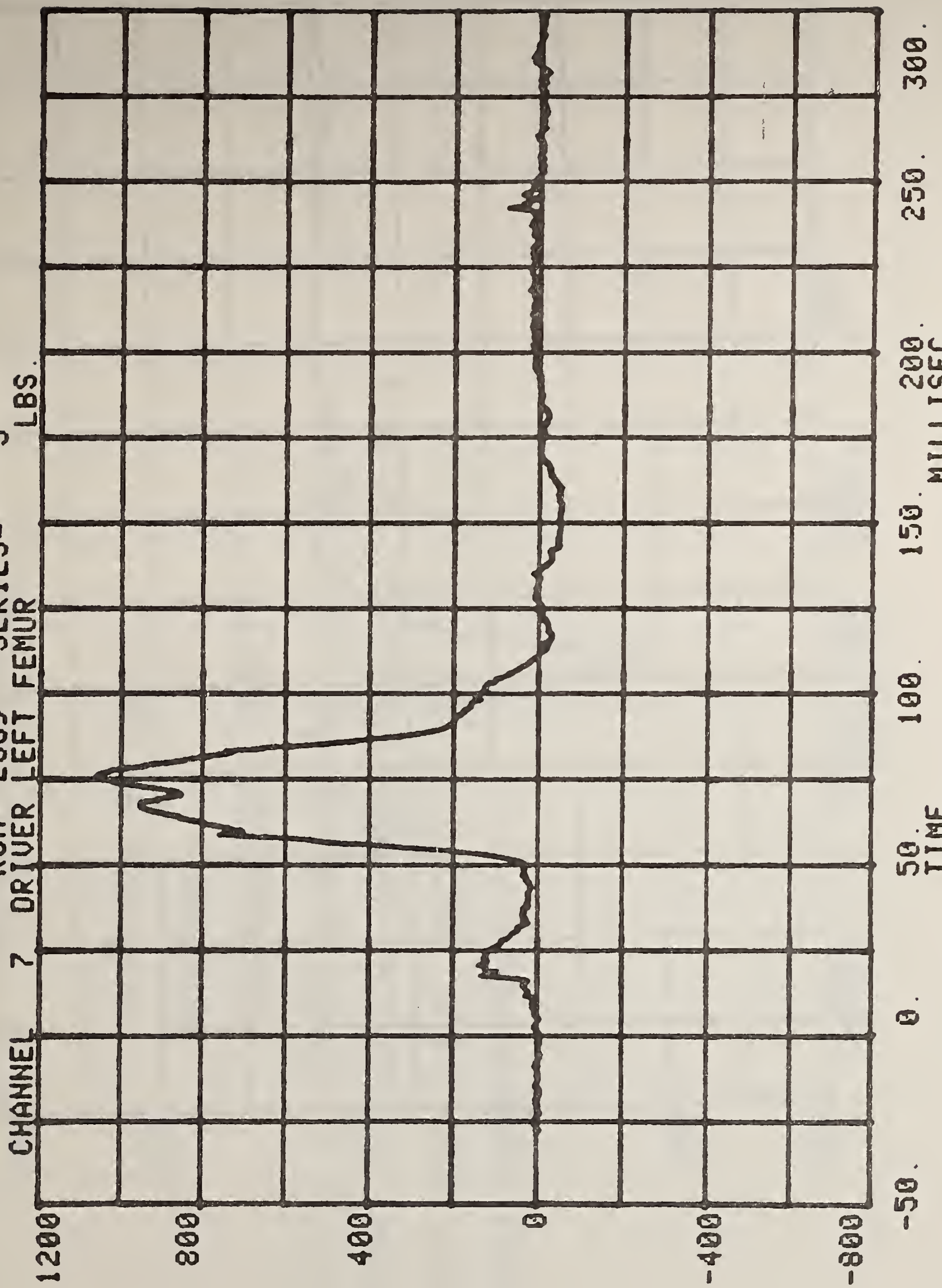

CHANNEL 4 RUN= 2589 SERIES= 5
DRIVER CHEST X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

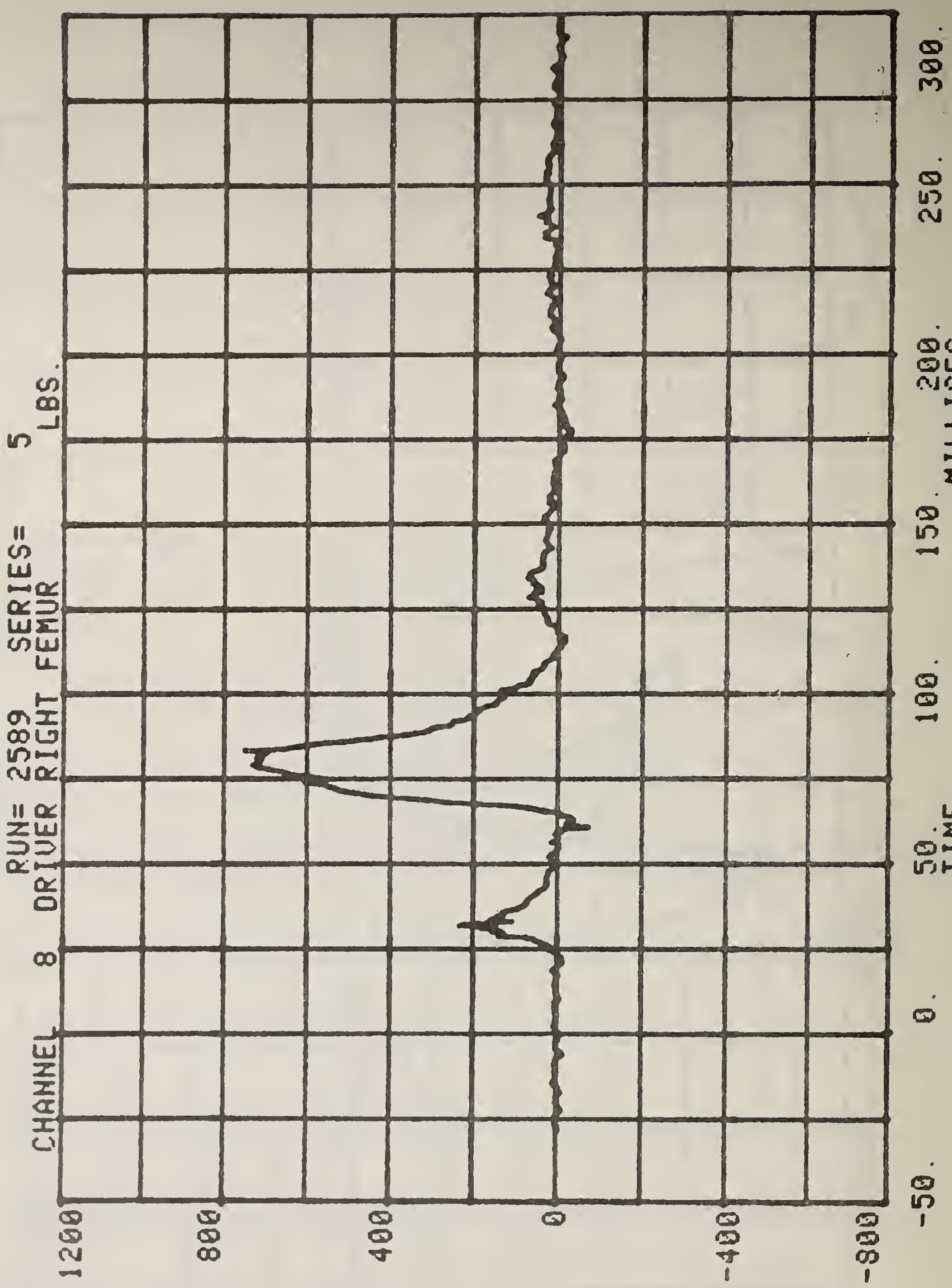

RUN= 2589 SERIES= 5
CHANNEL 5 DRIVER CHEST Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 6 RUN= 2589 SERIES= 5
DRIVER CHEST Z
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



RUN= 2589 SERIES= 5
CHANNEL 2 DRIVER CHEST RESULT. G'S
50.
40.
30.
20.
10
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 7 RUN= 2589 SERIES= 5
DRIVER LEFT FEMUR LBS.
1200
800
400
0
-400
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 8 RUN= 2589 SERIES= 5
DRIVER RIGHT FEMUR LBS.
1200
800
400
0
-400
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2589

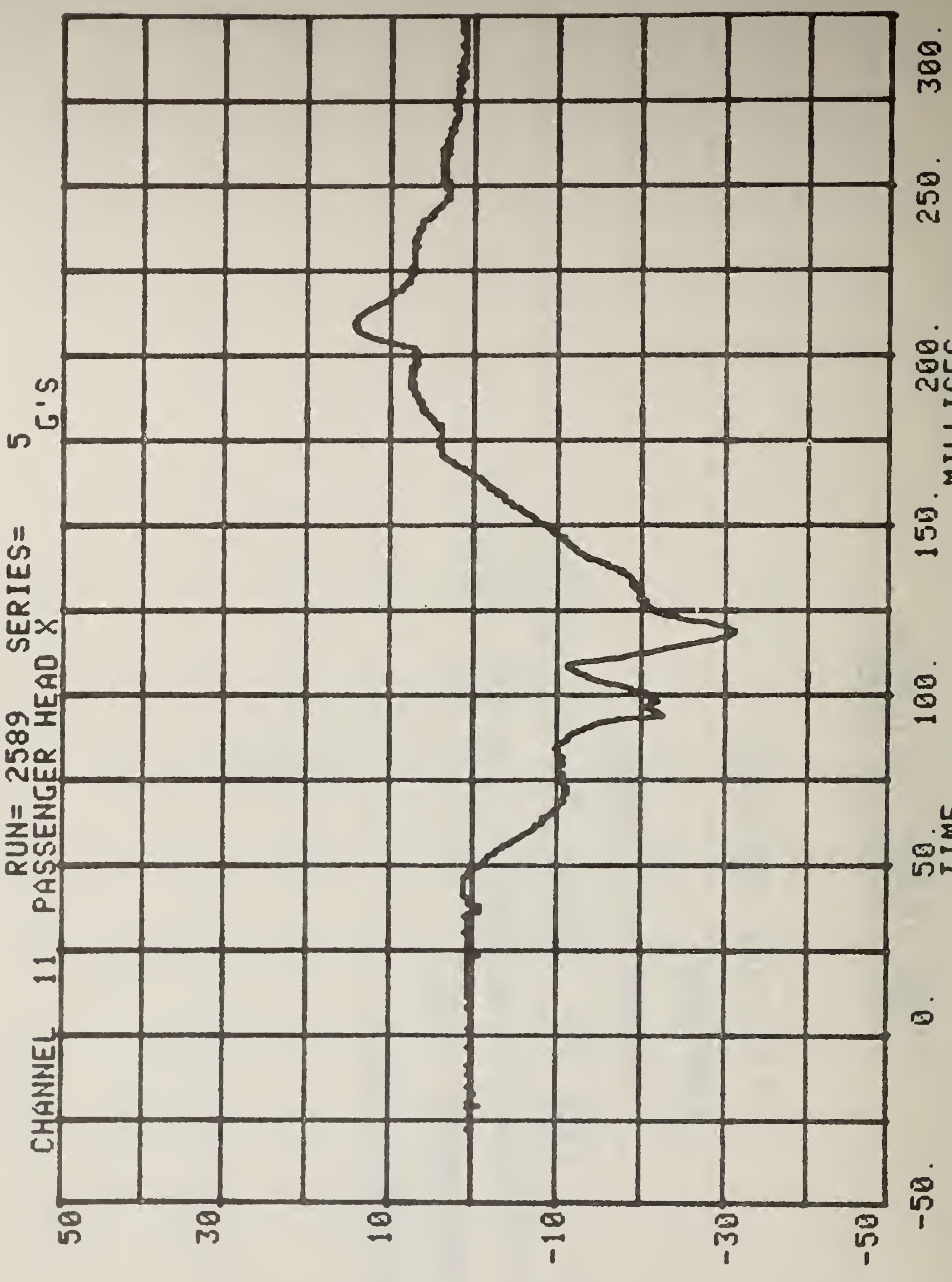
PASSENGER HEAD RESULT.

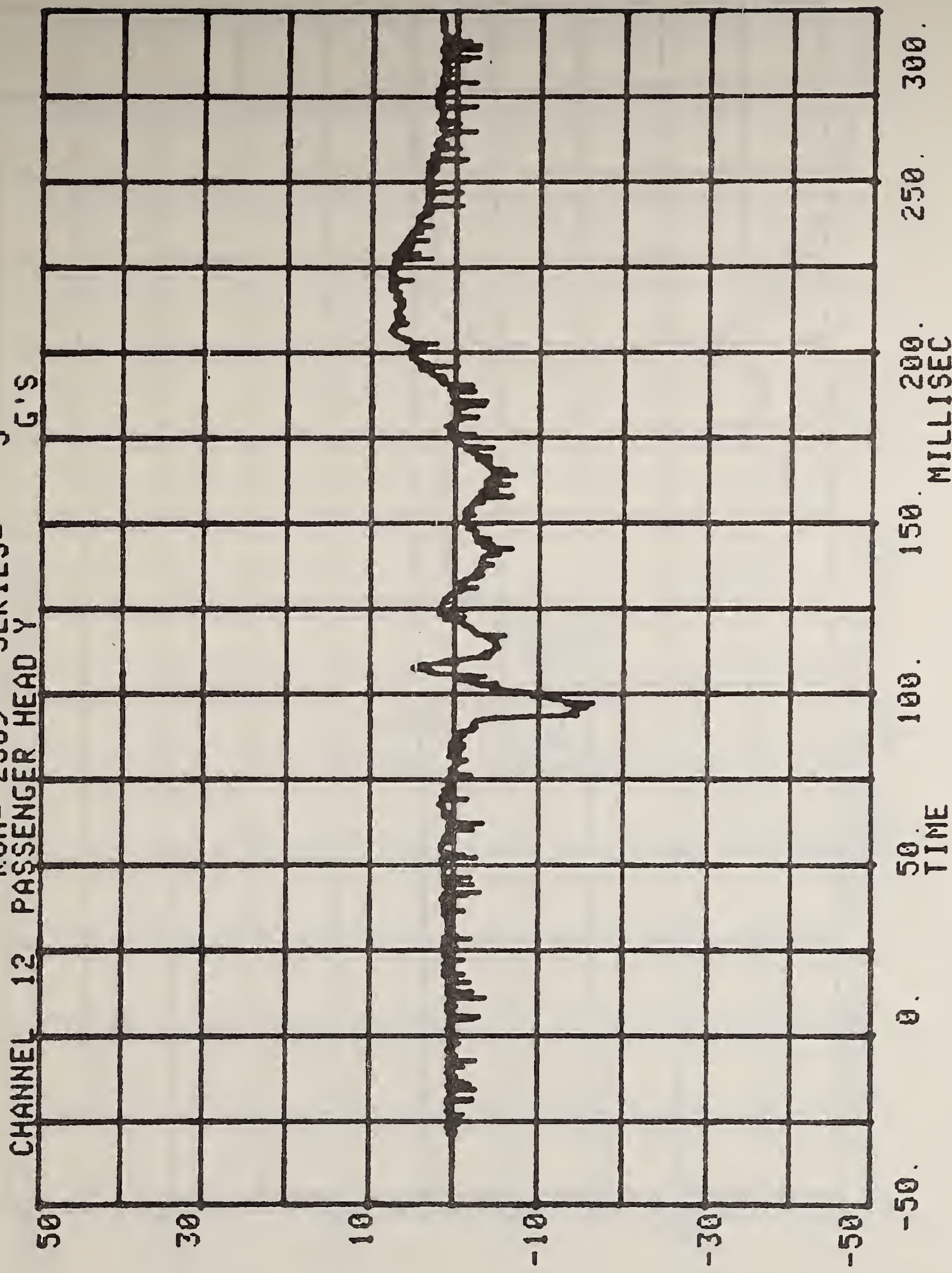
HIC= 381.1   FROM T1= .07290   TO T2= .13590

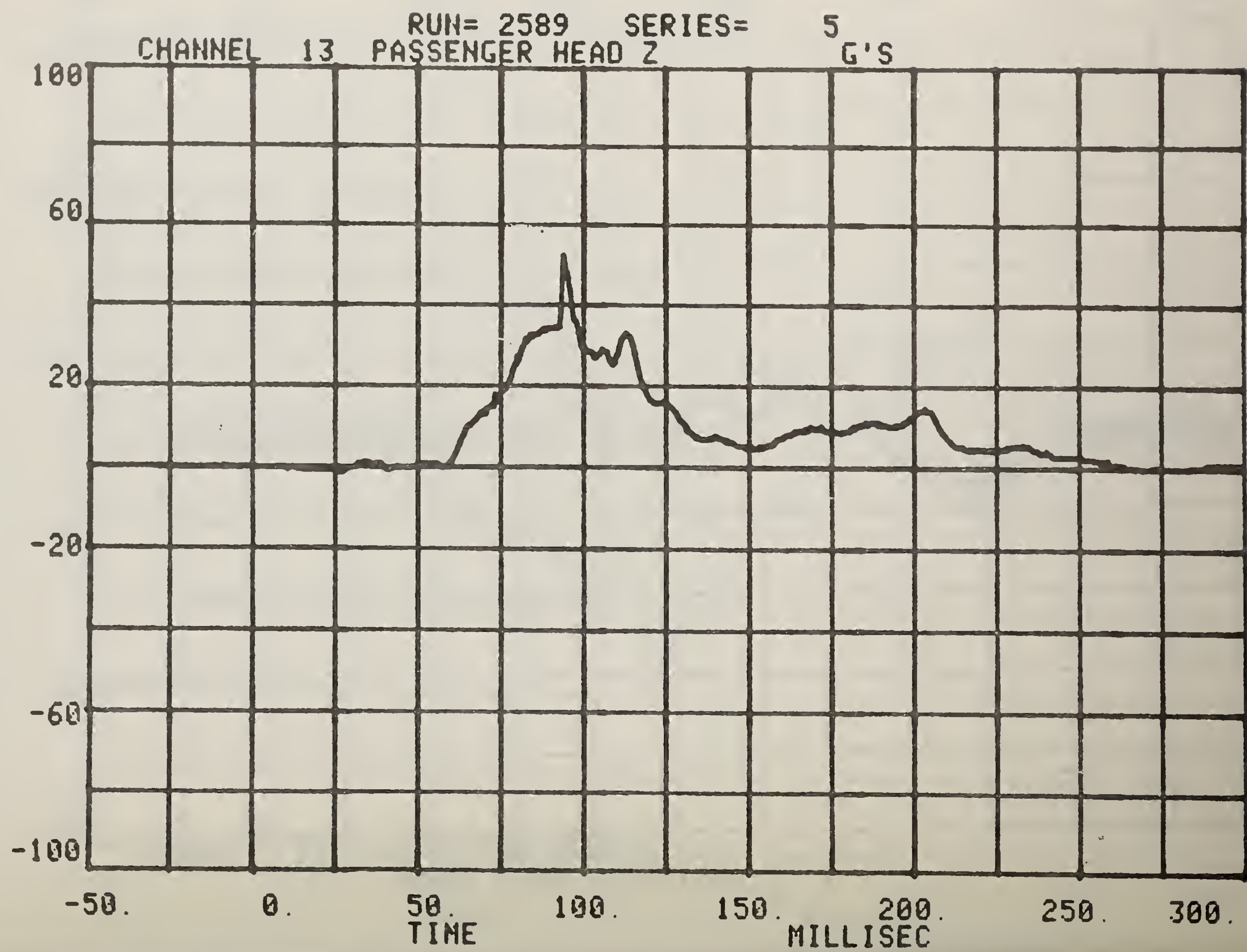
AVERAGE ACCELERATION BETWEEN T1 AND T2= 32.6G'S

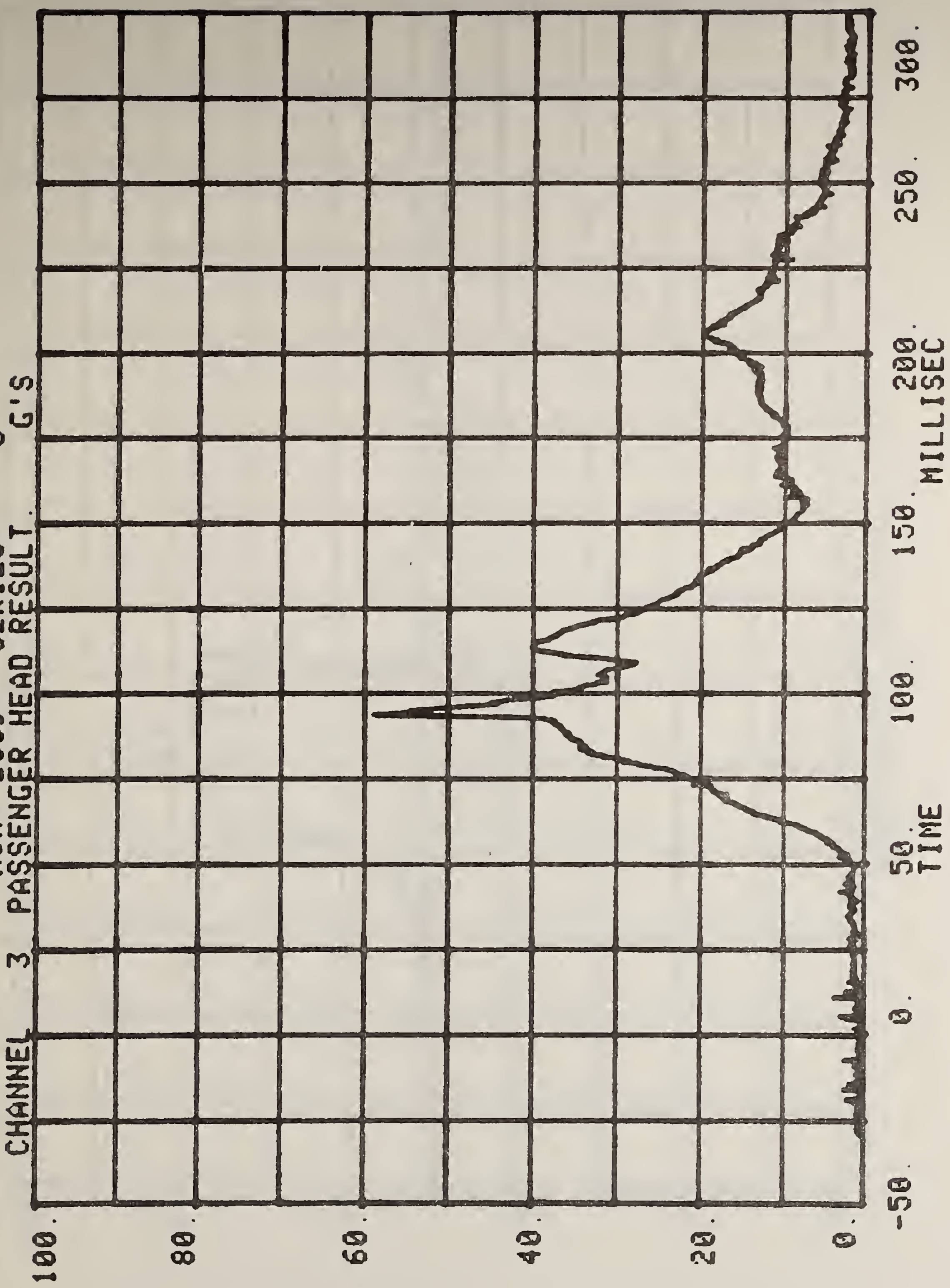
EVENT TIME= 300.0 MSEC

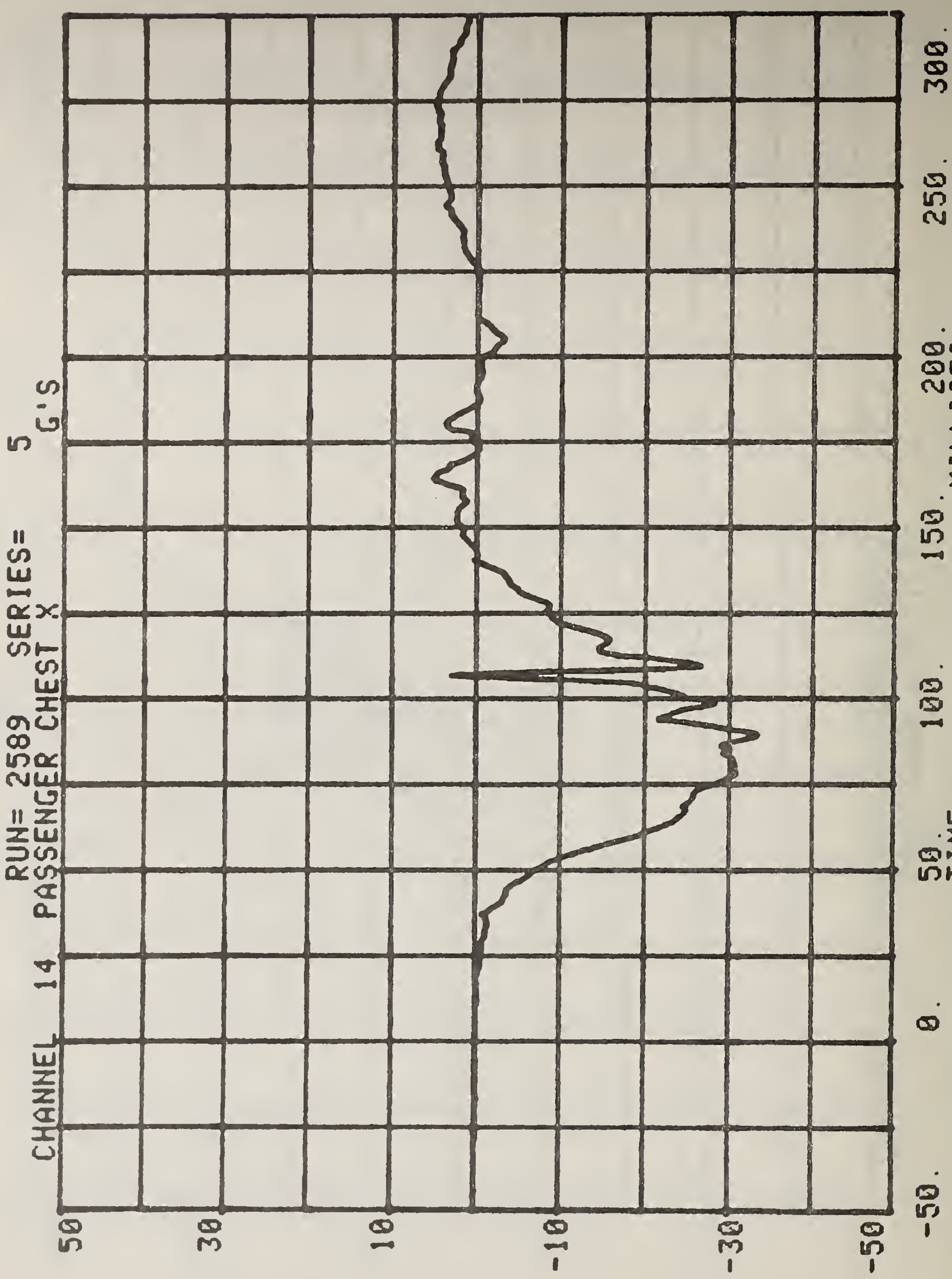
SEVERITY INDEX= 505.6

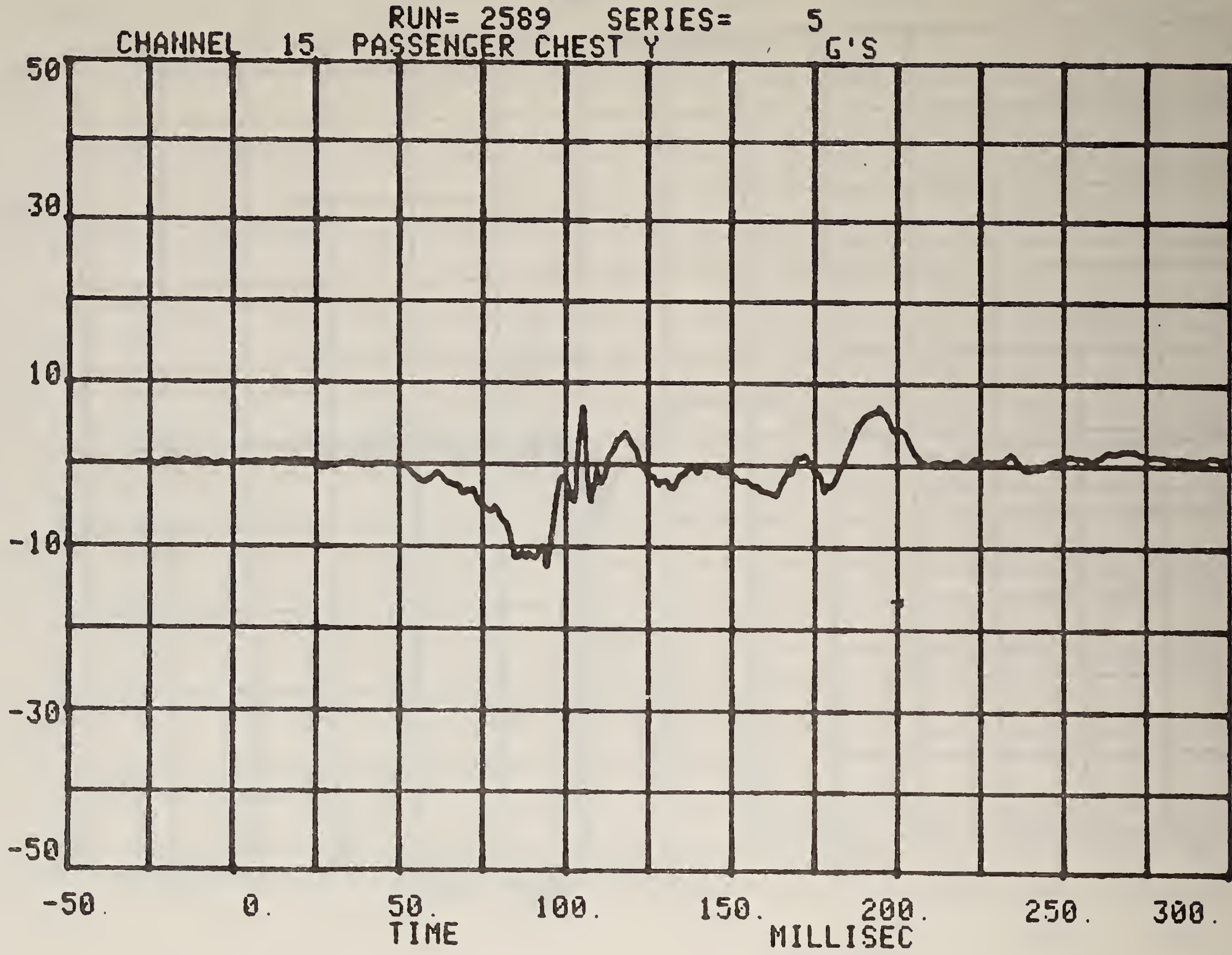

CHANNEL 11 RUN= 2589 SERIES= 5
PASSENGER HEAD X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

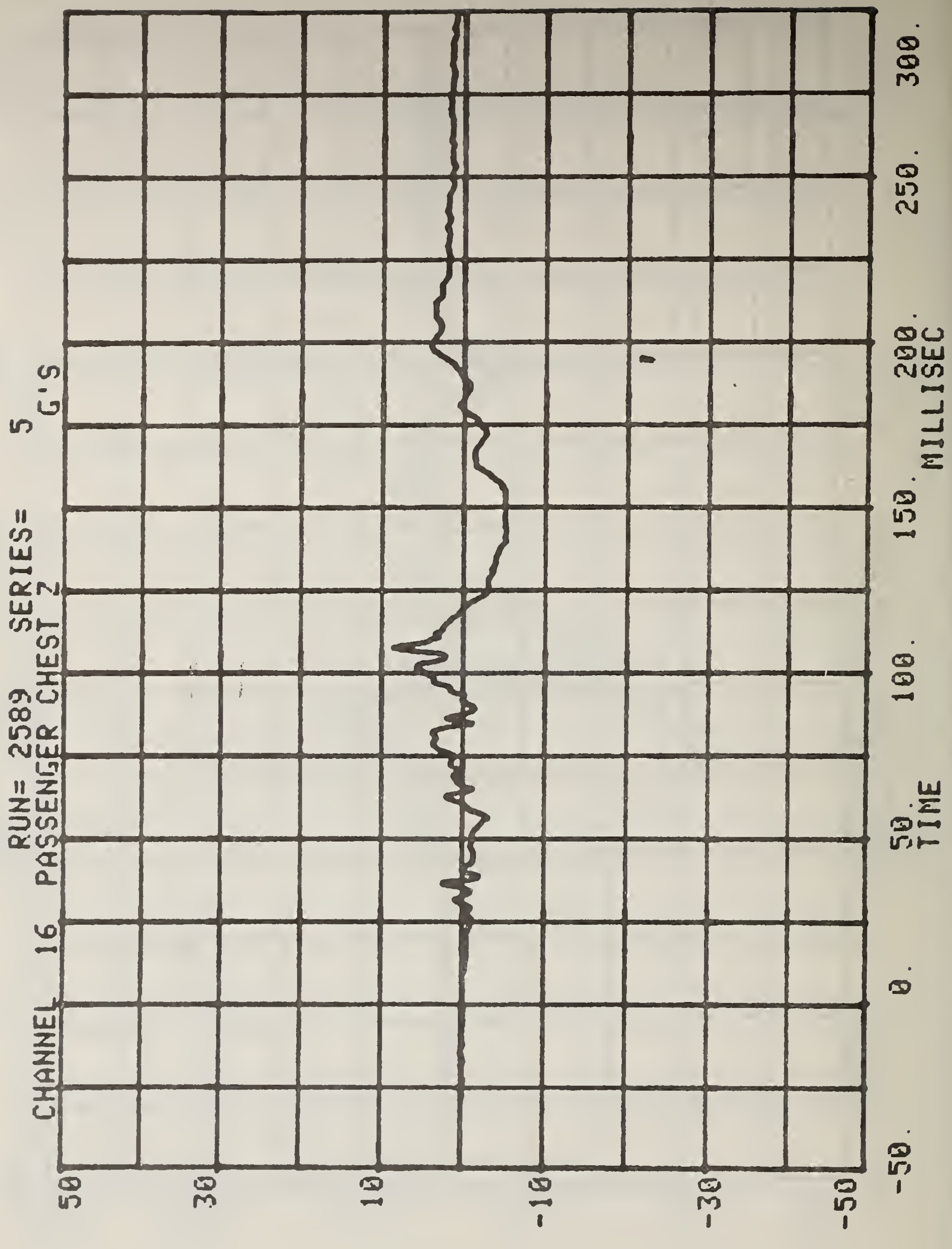

CHANNEL 12 RUN= 2589 SERIES= 5
PASSENGER HEAD Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

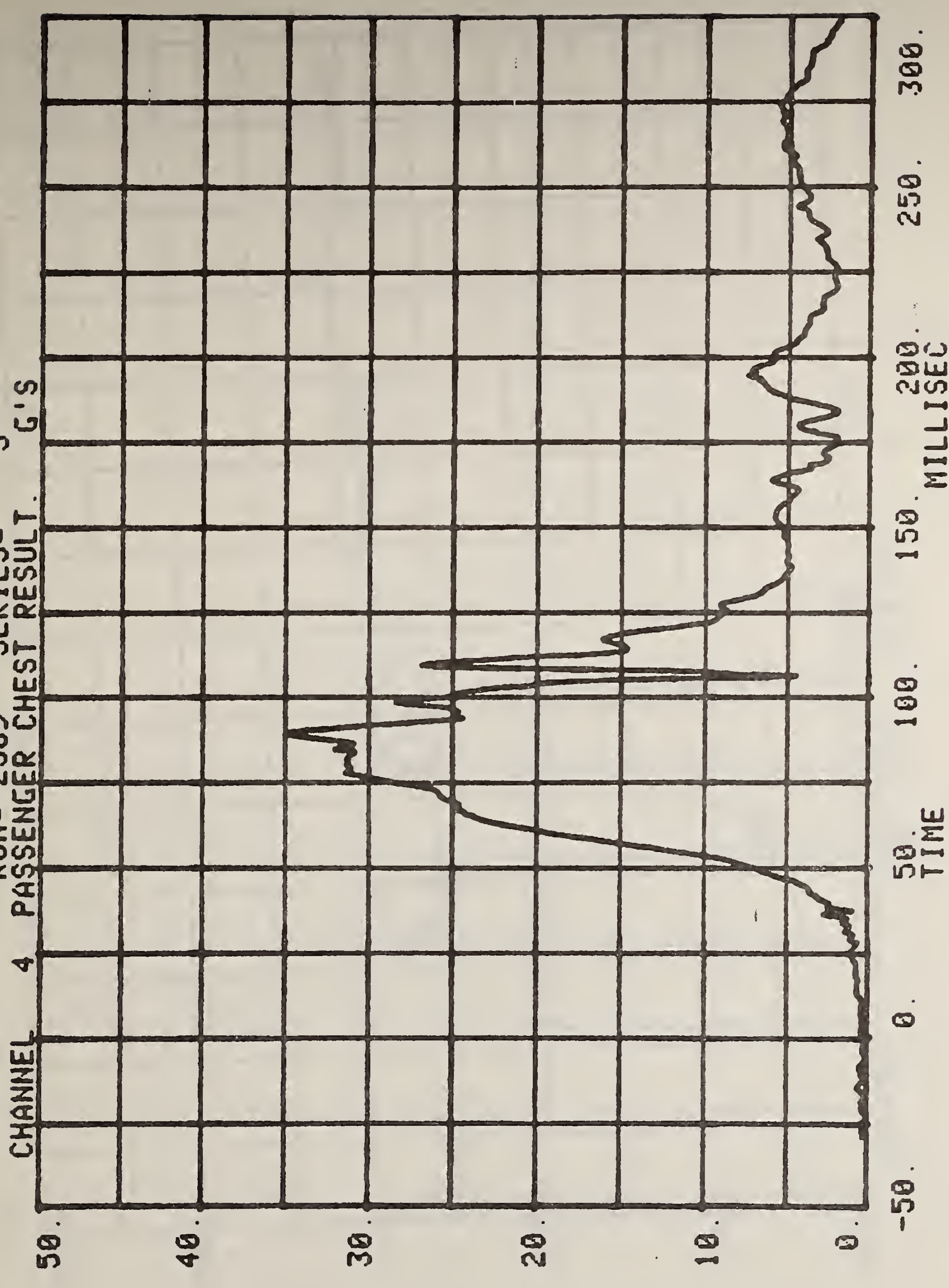

RUN= 2589 SERIES= 5
CHANNEL 13 PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 3 RUN= 2589 SERIES= 5
PASSENGER HEAD RESULT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

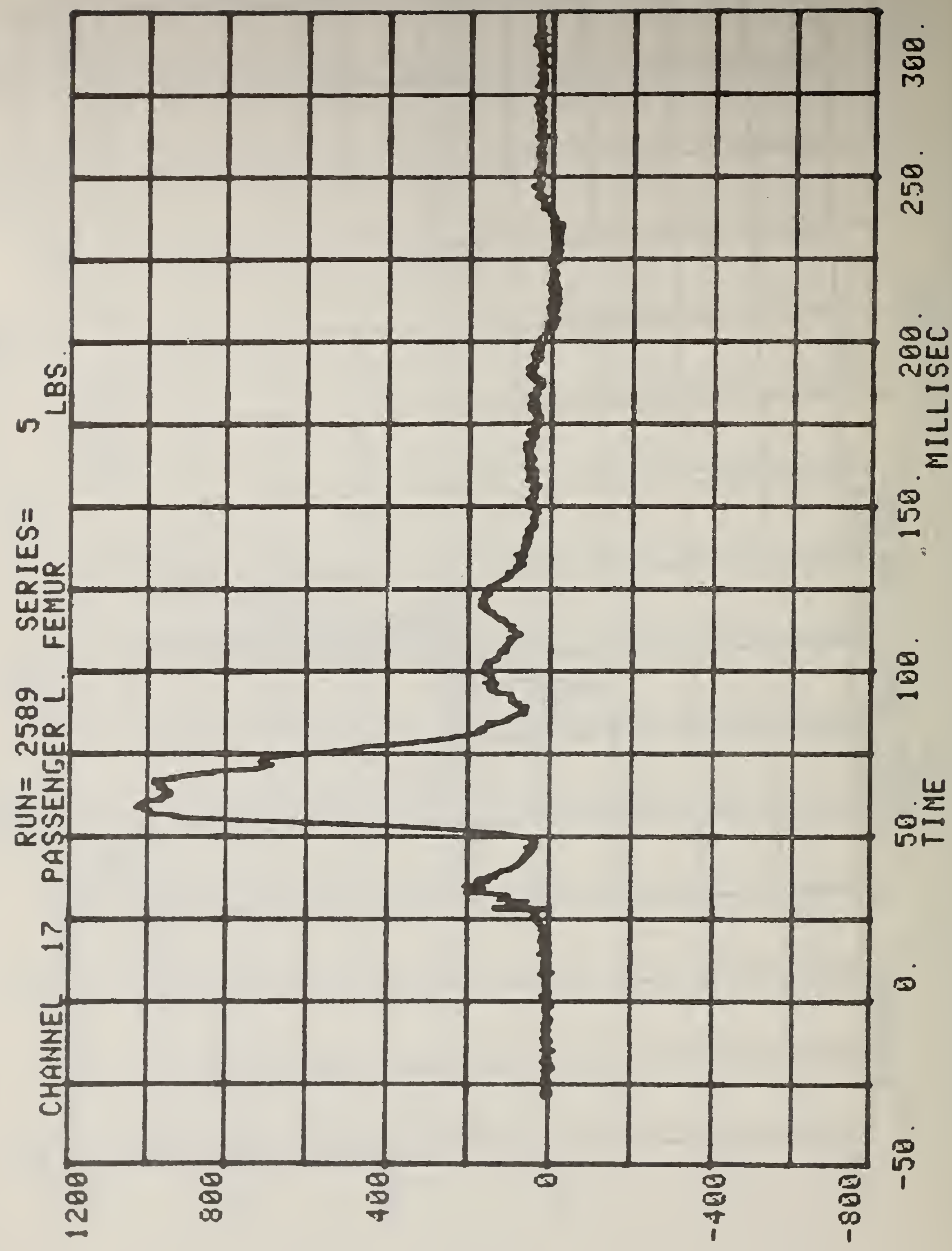

CHANNEL 14 RUN= 2589 SERIES= 5
PASSENGER CHEST X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

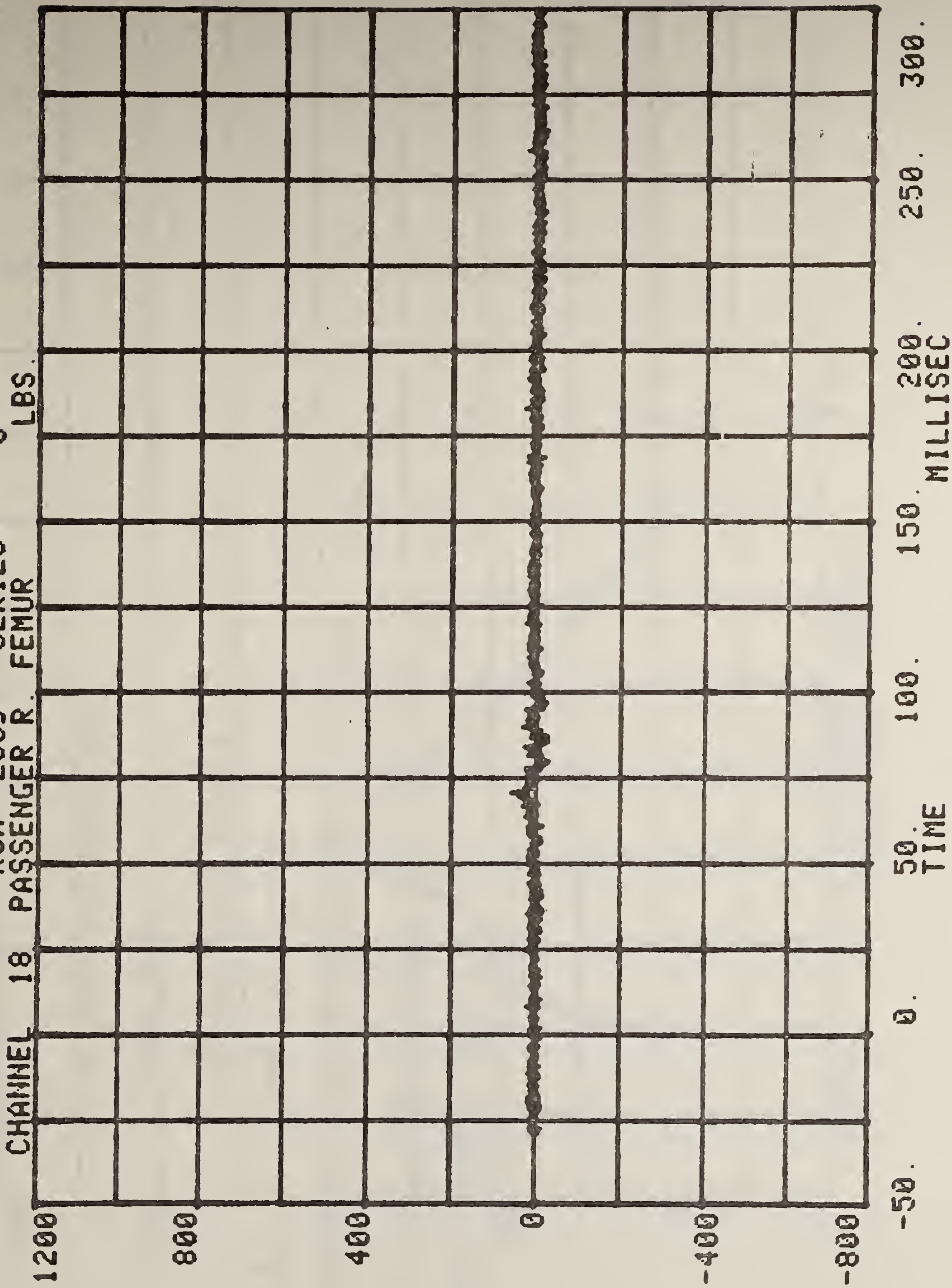

RUN= 2589 SERIES= 5
CHANNEL 15 PASSENGER CHEST Y G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

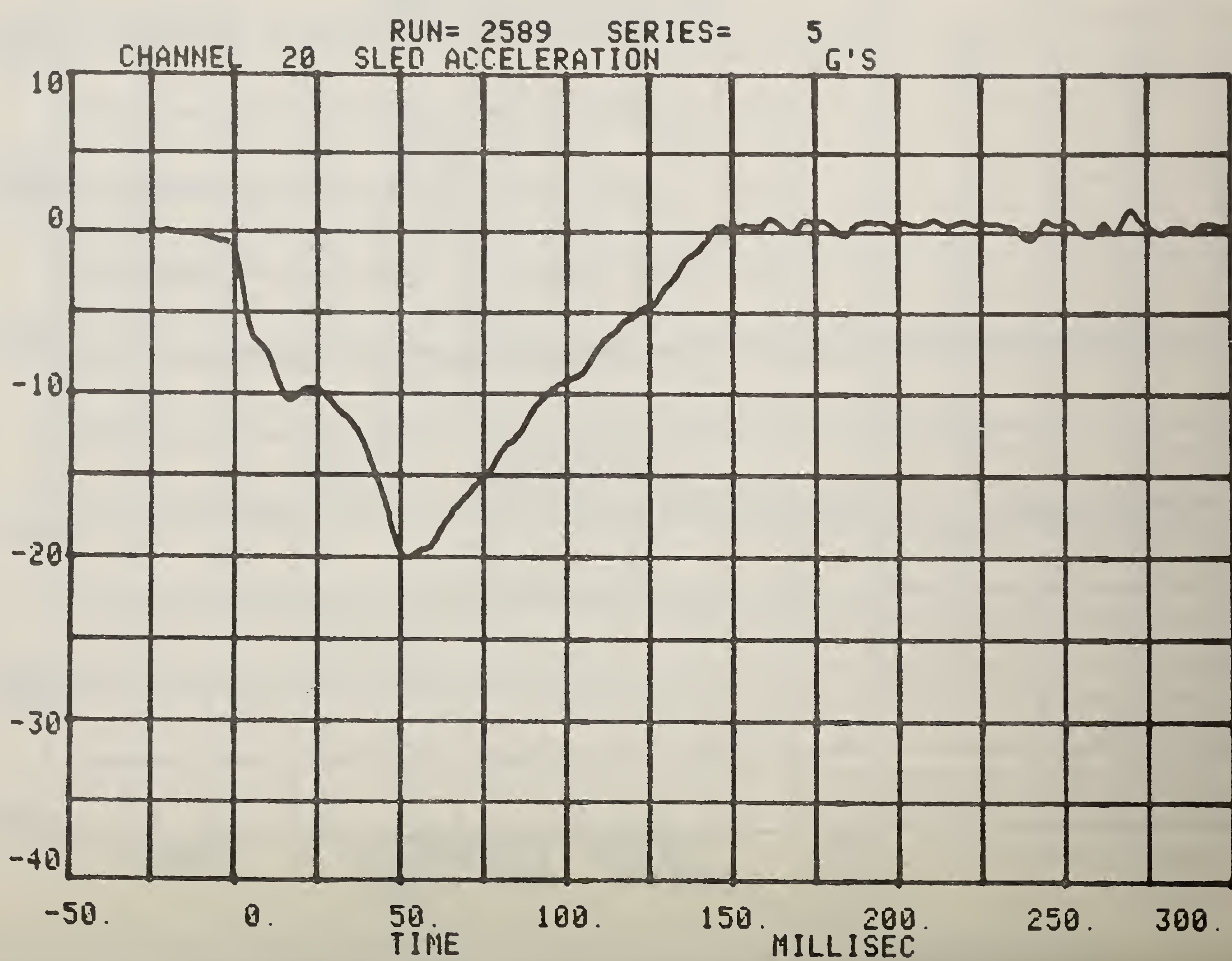

CHANNEL 16 RUN= 2589 SERIES= 5
PASSENGER CHEST Z
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



CHANNEL 4 RUN= 2589 SERIES= 5
PASSENGER CHEST RESULT. G'S
50.
40.
30.
20.
10.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 17 RUN= 2589 SERIES= 5
PASSENGER L. FEMUR LBS
1200
800
400
0
-400
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 18 RUN= 2589 SERIES= 5
PASSENGER R. FEMUR LBS.
1200
800
400
0
-400
-800
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2589 SERIES= 5
CHANNEL 20 SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2590

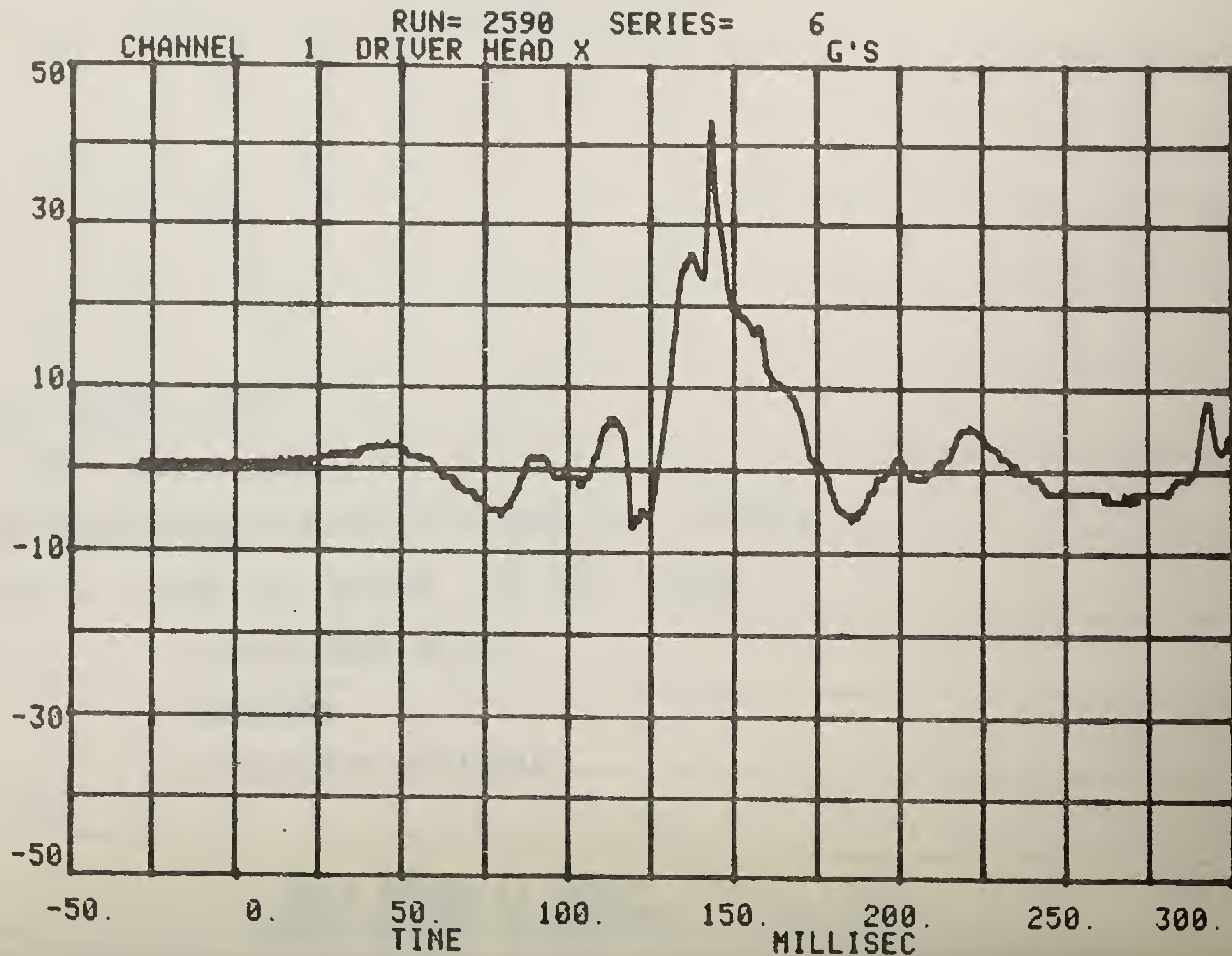
DRIVER HEAD RESULT.

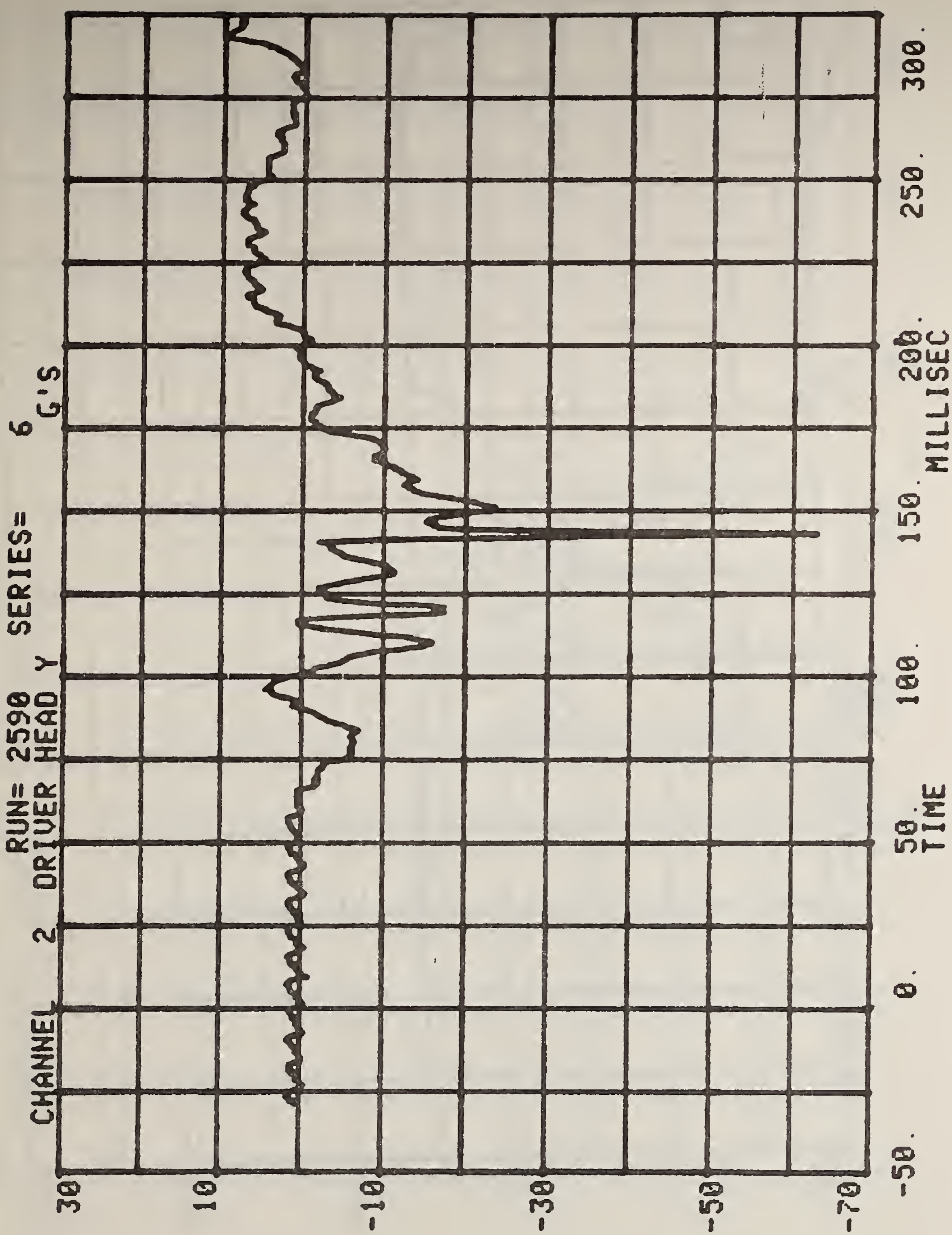
HIC= 247.7   FROM T1= .07830   TO T2= .17010

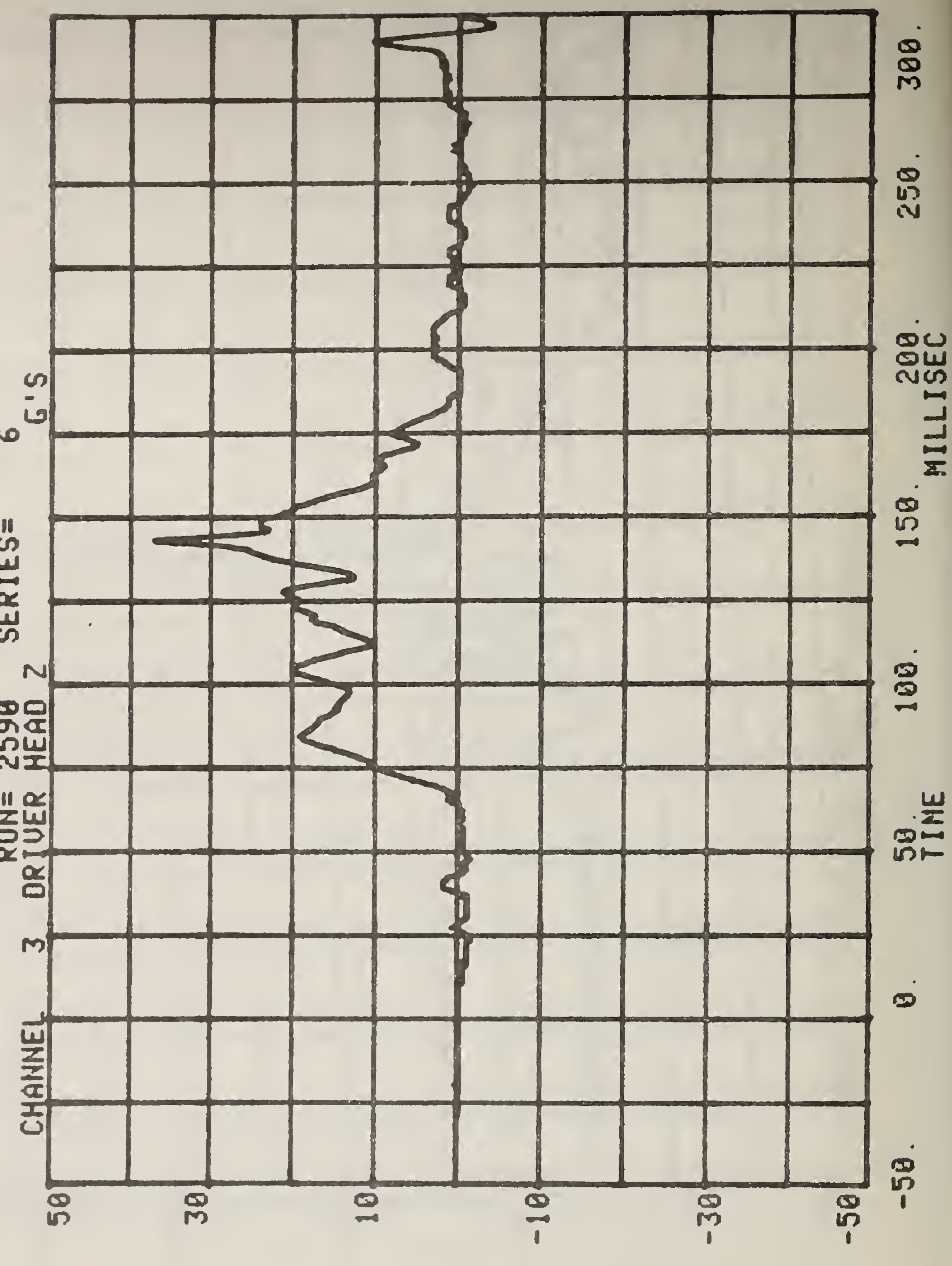
AVERAGE ACCELERATION BETWEEN T1 AND T2= 23.6G'S

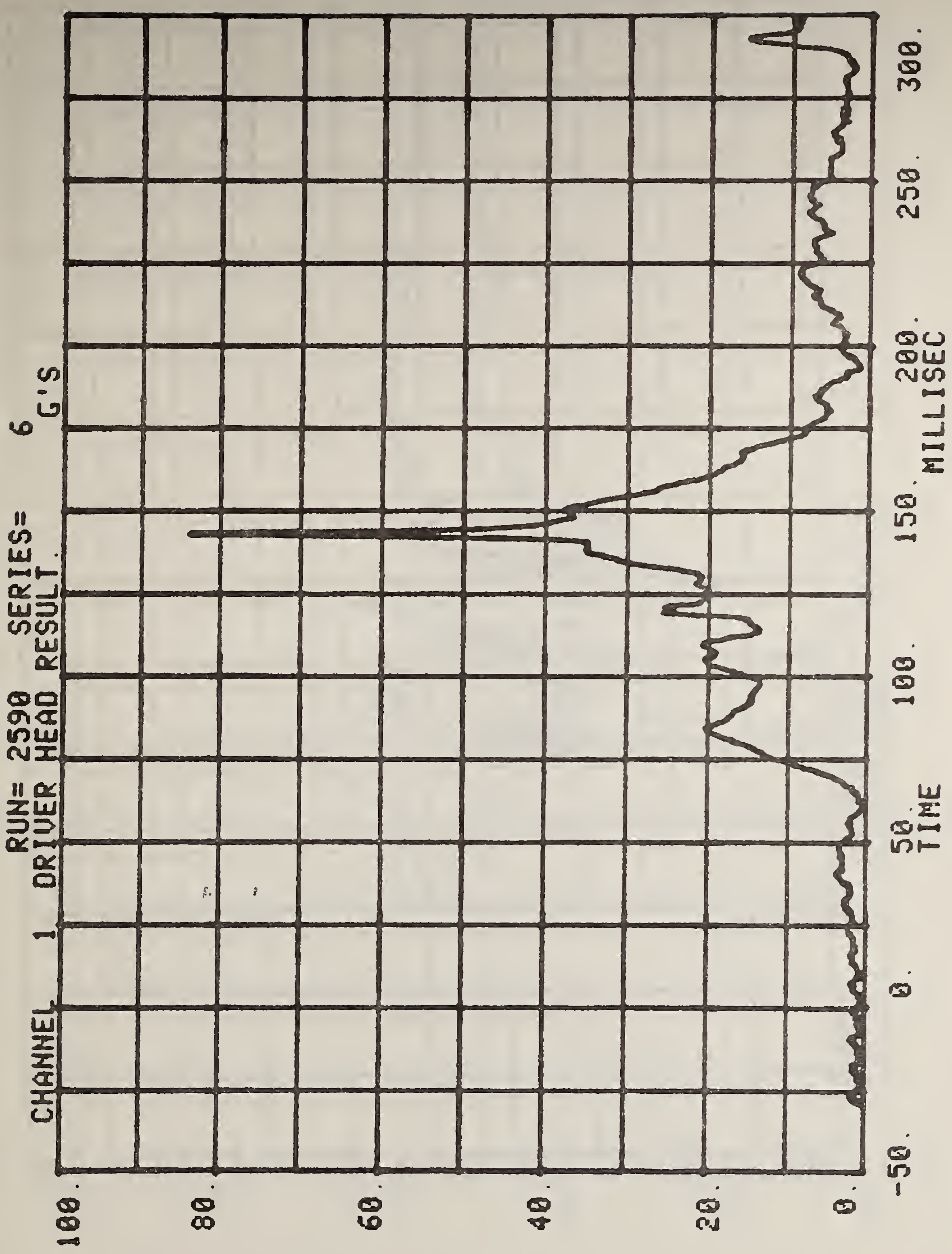
EVENT TIME= 300.0 MSEC

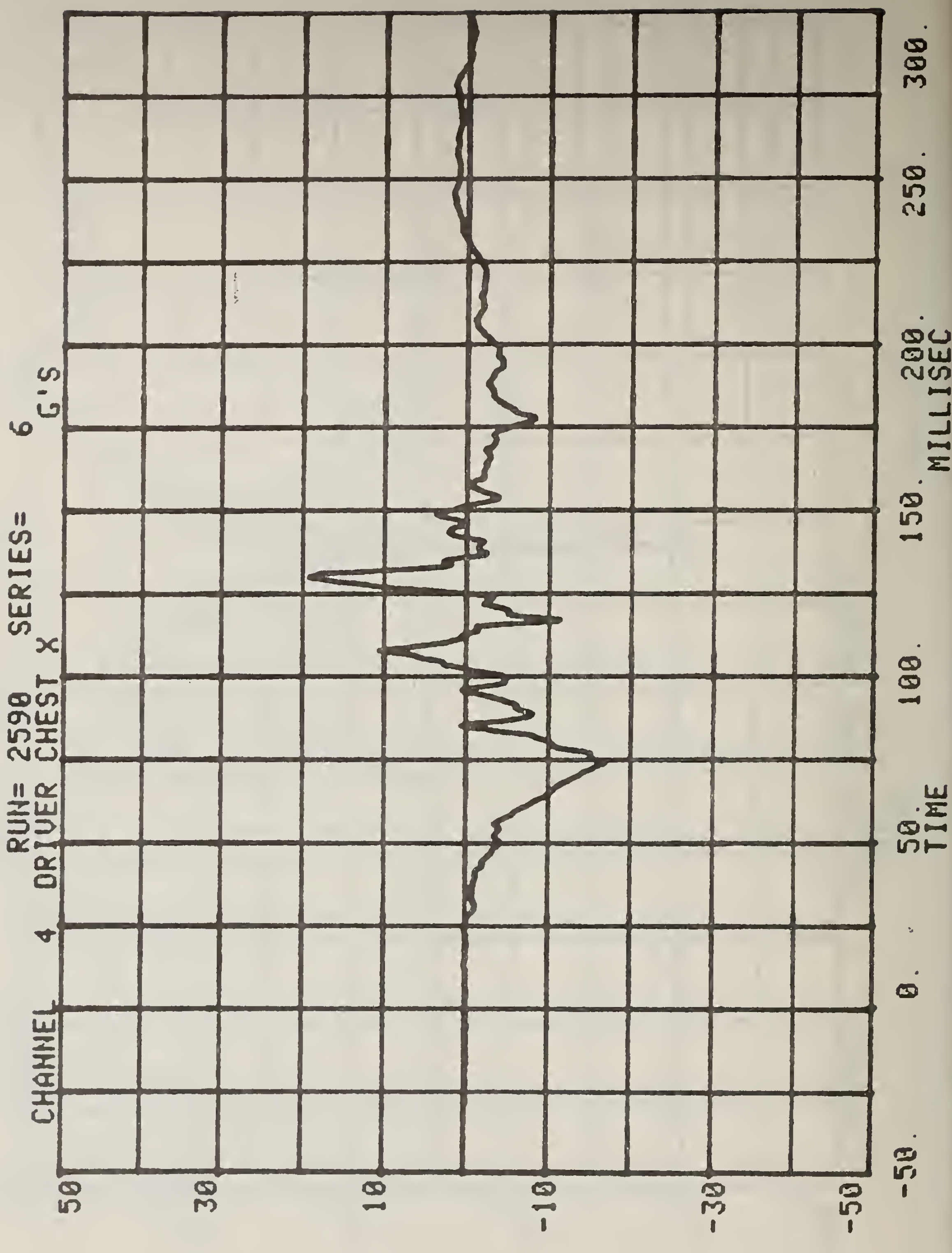
SEVERITY INDEX= 379.2


RUN= 2590 SERIES= 6
CHANNEL 1 DRIVER HEAD X
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

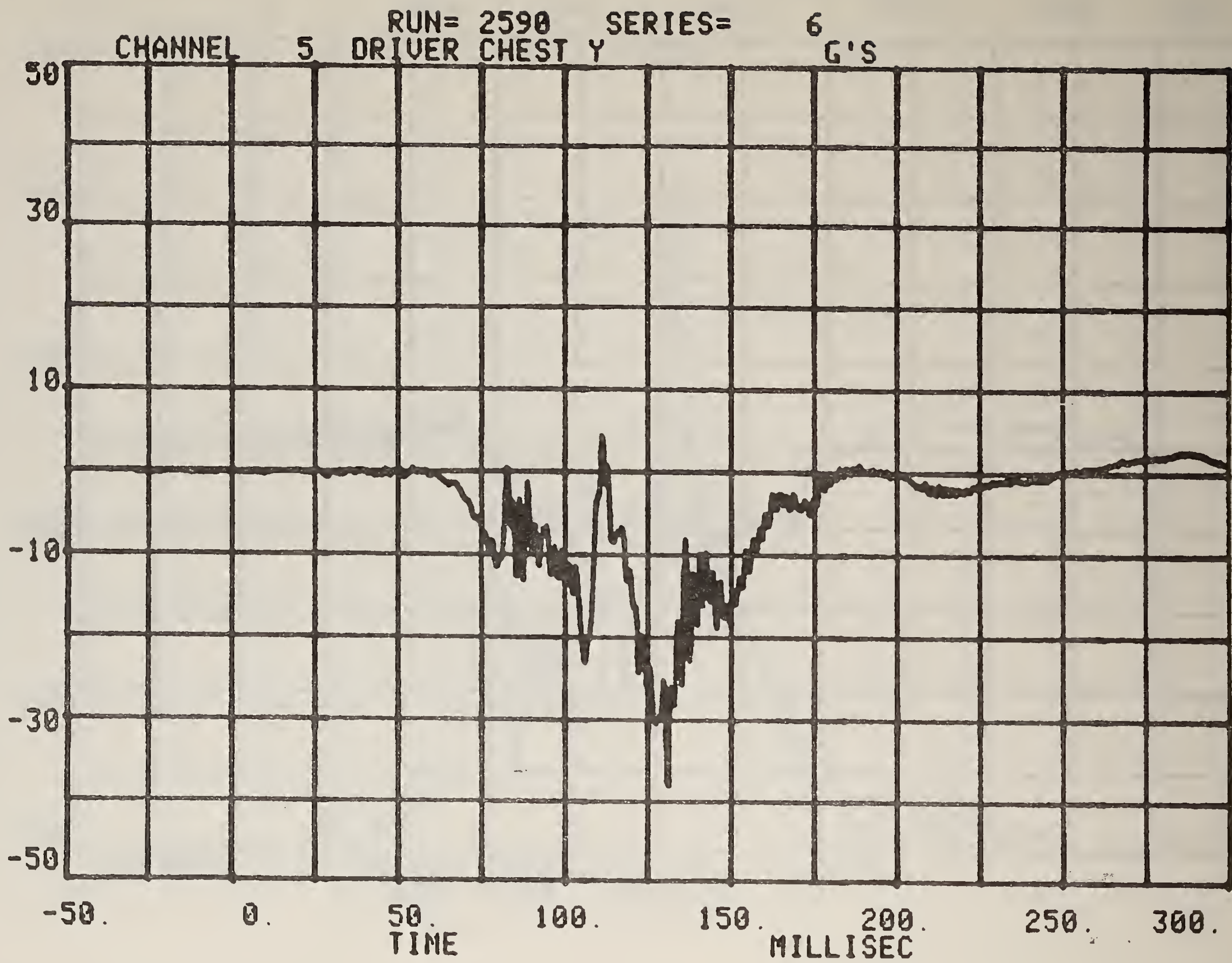

CHANNEL 2 RUN= 2590 SERIES= 6
DRIVER HEAD Y G'S
30
10
-10
-30
-50
-70
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

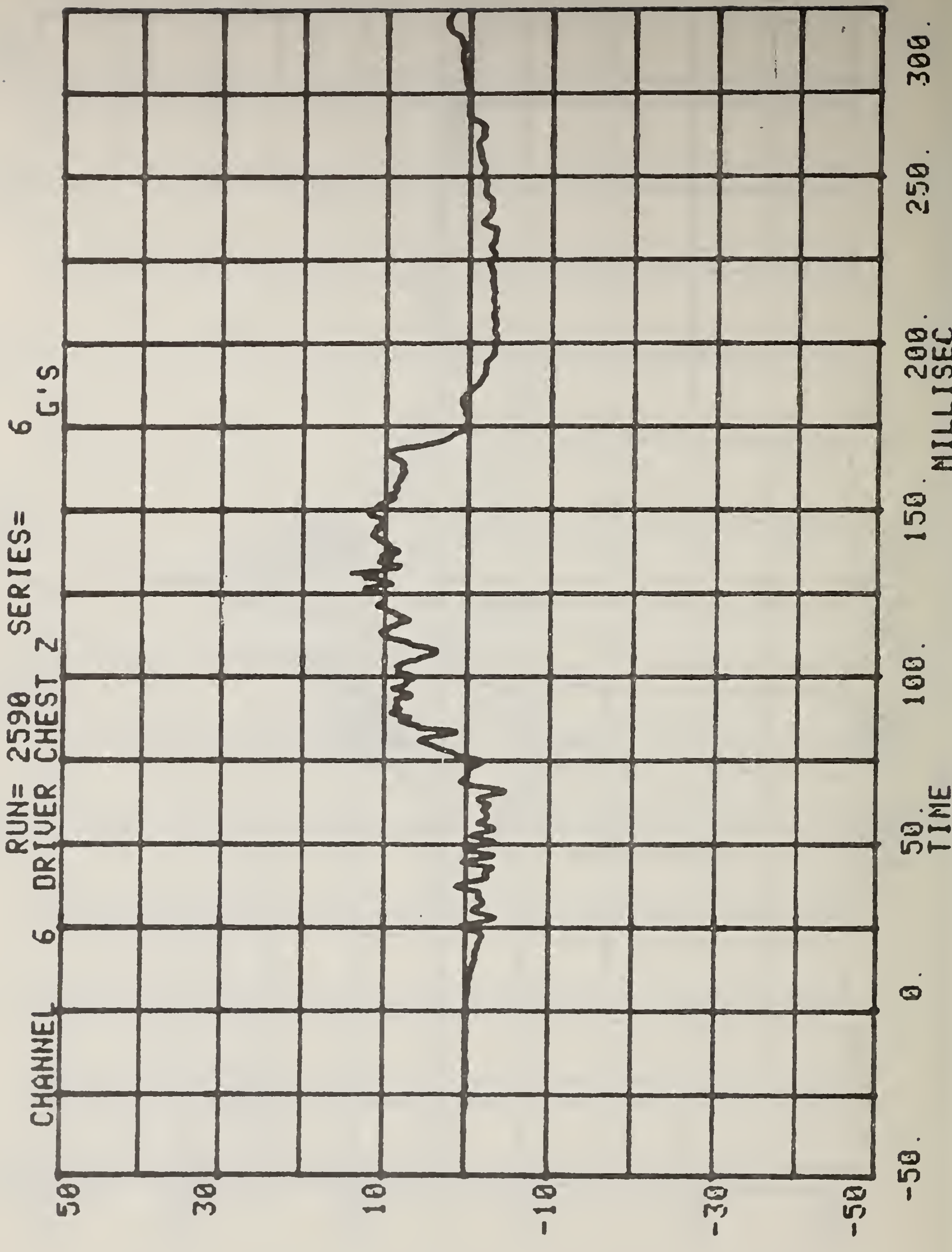

CHANNEL 3 RUN= 2590 SERIES= 6
DRIVER HEAD 2 G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

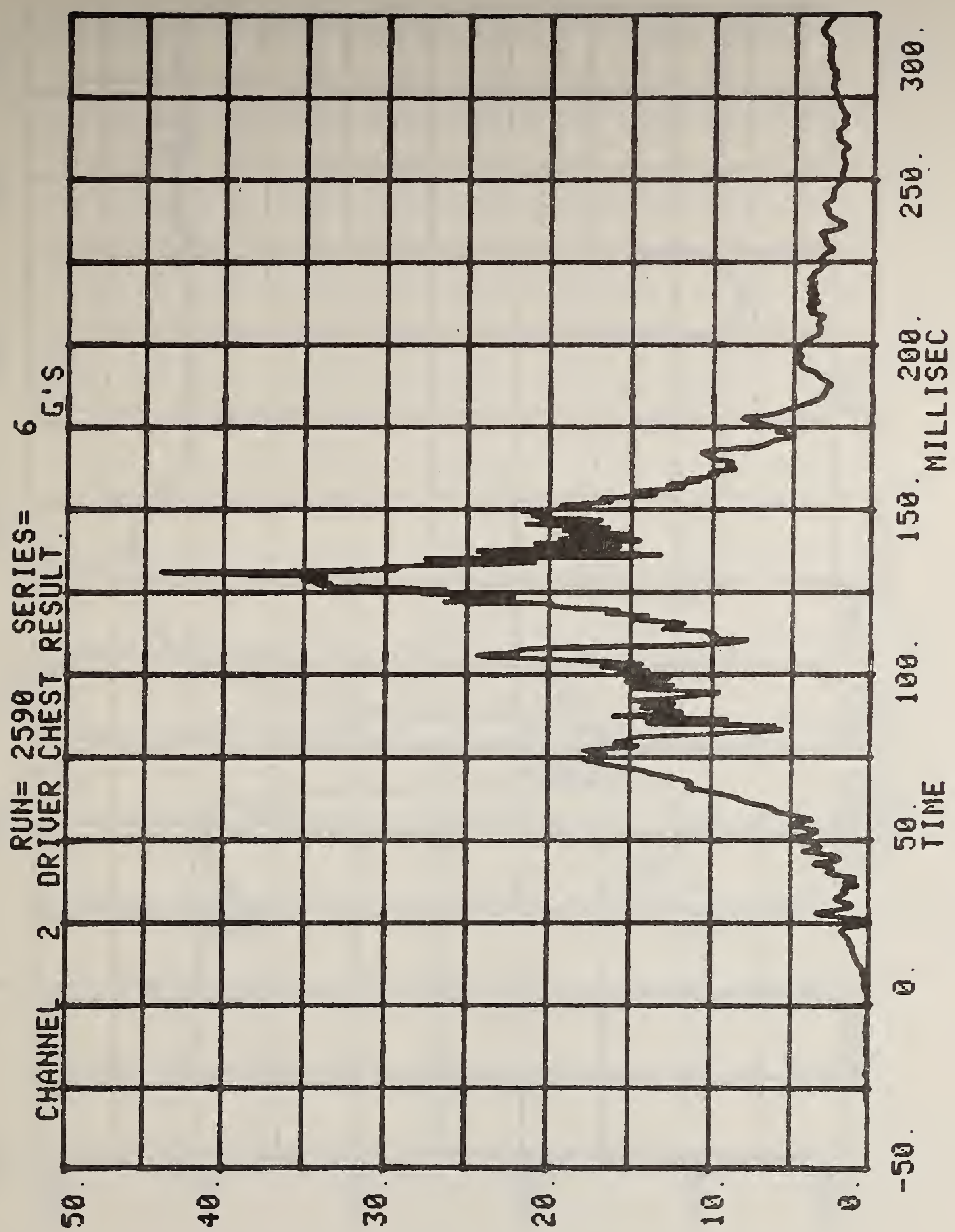

CHANNEL 1 RUN= 2590 SERIES= 6
DRIVER HEAD RESULT. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

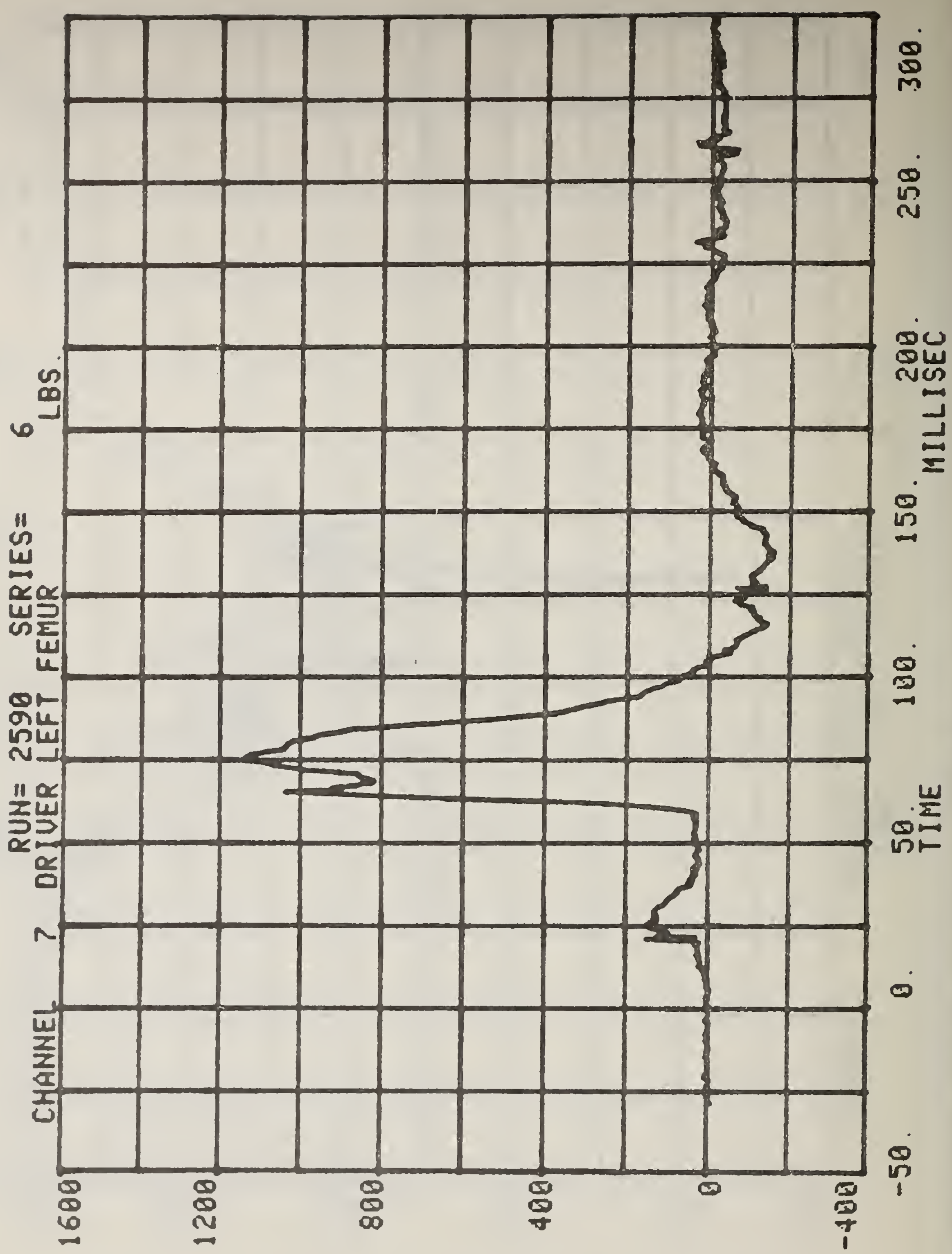


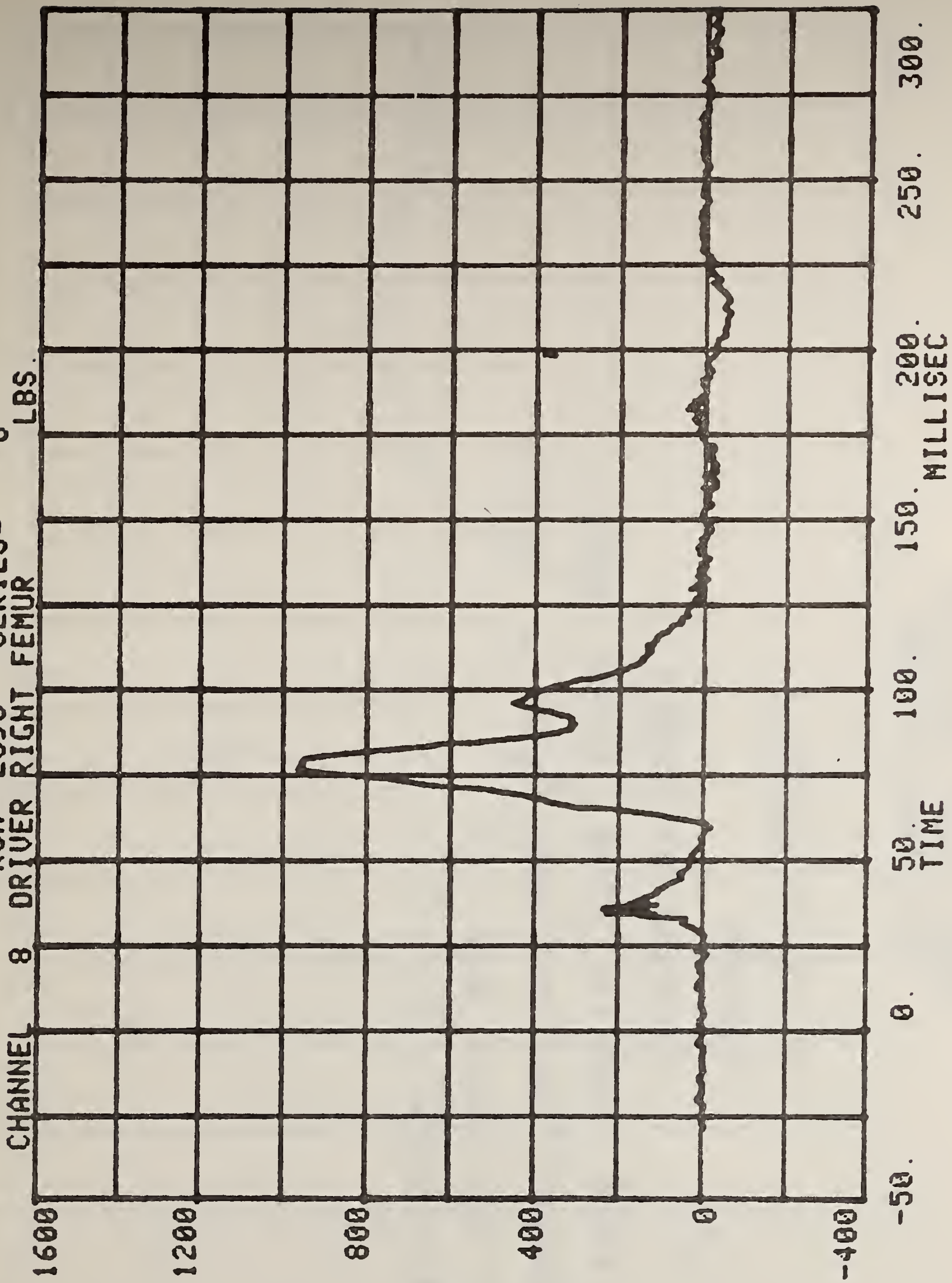
CHANNEL 4 RUN= 2590 SERIES= 6
DRIVER CHEST X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2590 SERIES= 6
CHANNEL 5 DRIVER CHEST Y
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 6 RUN= 2590 SERIES= 6
DRIVER CHEST Z G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 2 RUN= 2590 SERIES= 6
DRIVER CHEST RESULT G'S
50. 40. 30. 20. 10. 0.
-50. 0. 50. 100. 150. 200. 250. 300.
TIME MILLISEC


CHANNEL 7 RUN= 2590 SERIES= 6
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 8 RUN= 2590 SERIES= 6
DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2590

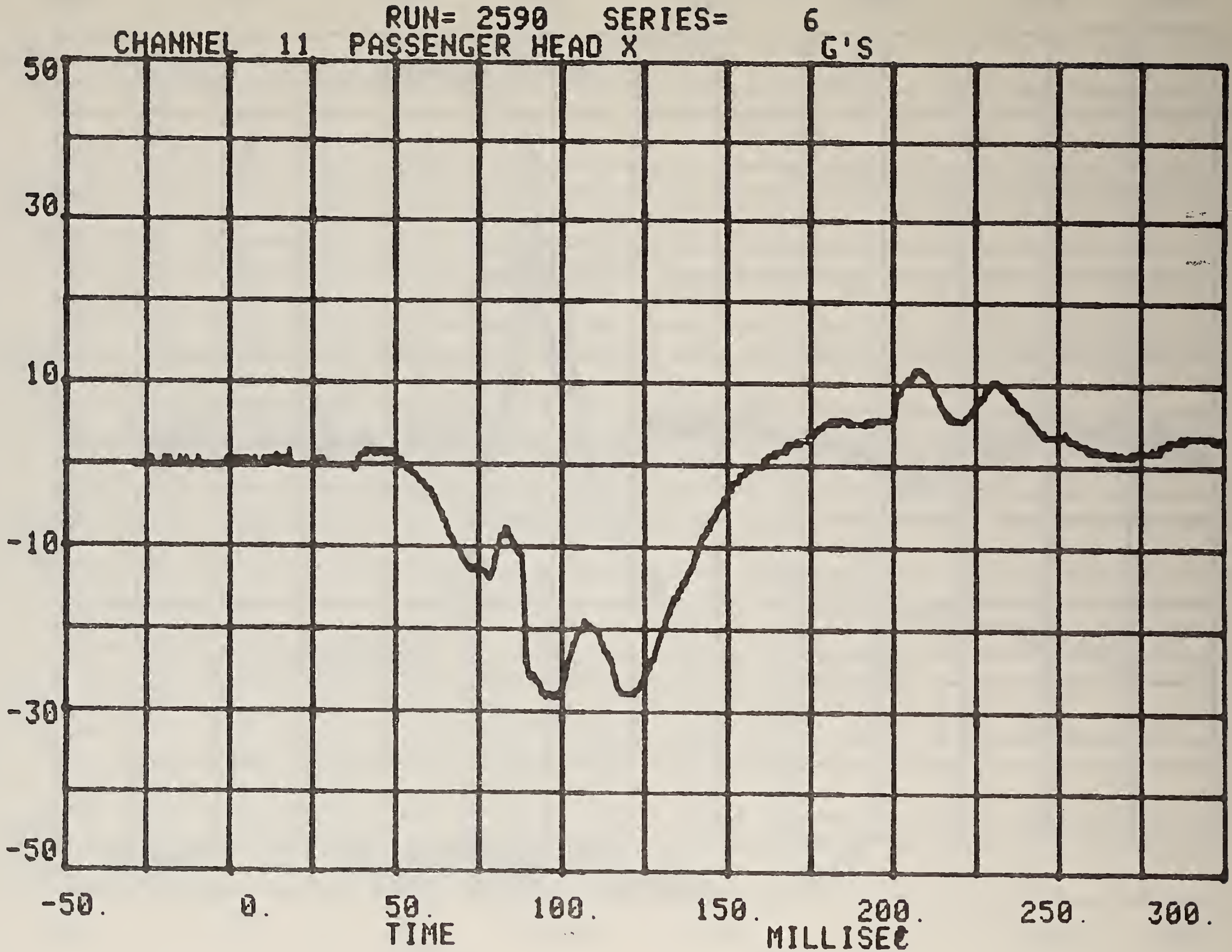
PASSENGER HEAD RESULT.

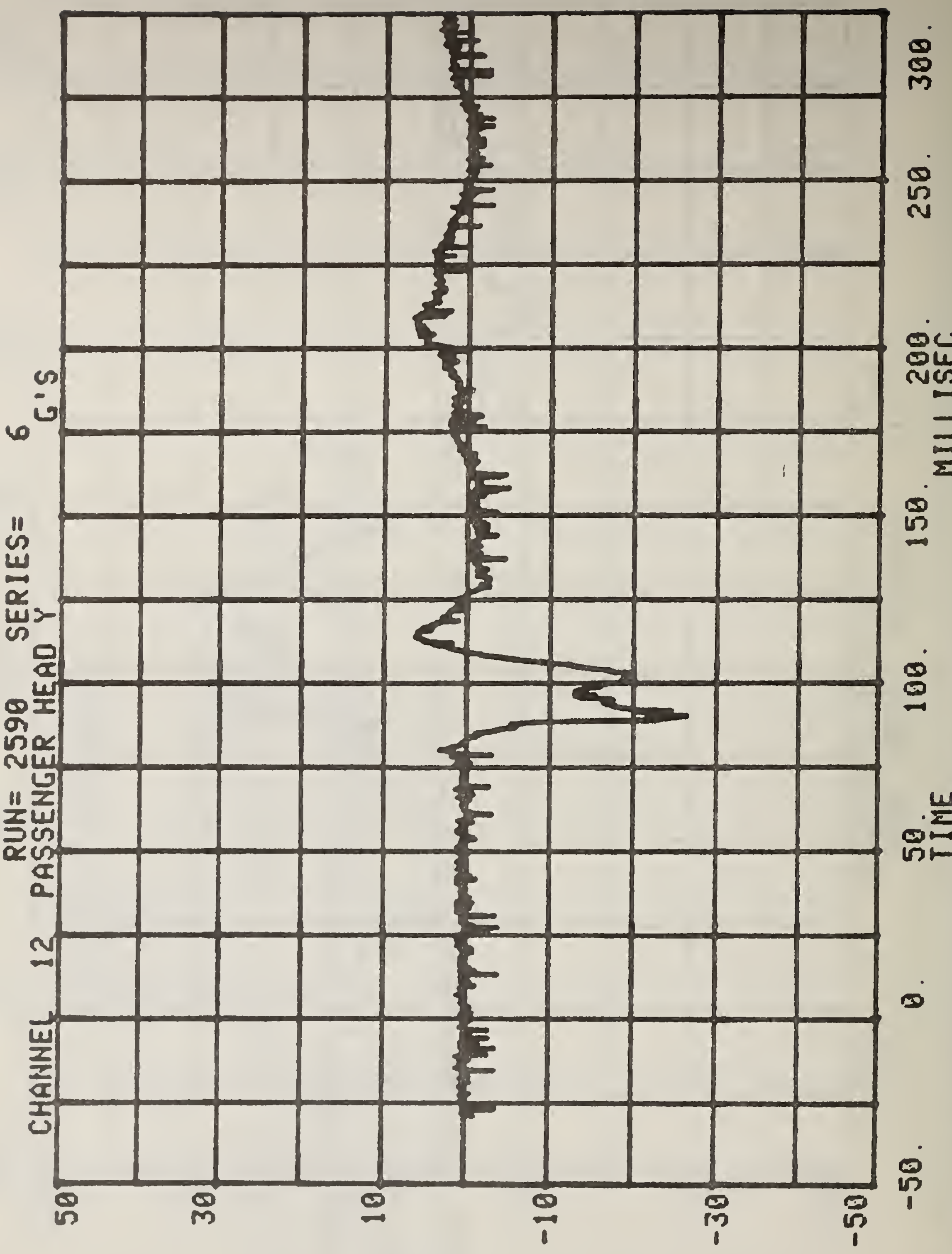
HIC= 448.0   FROM T1= .07530   TO T2= .12990

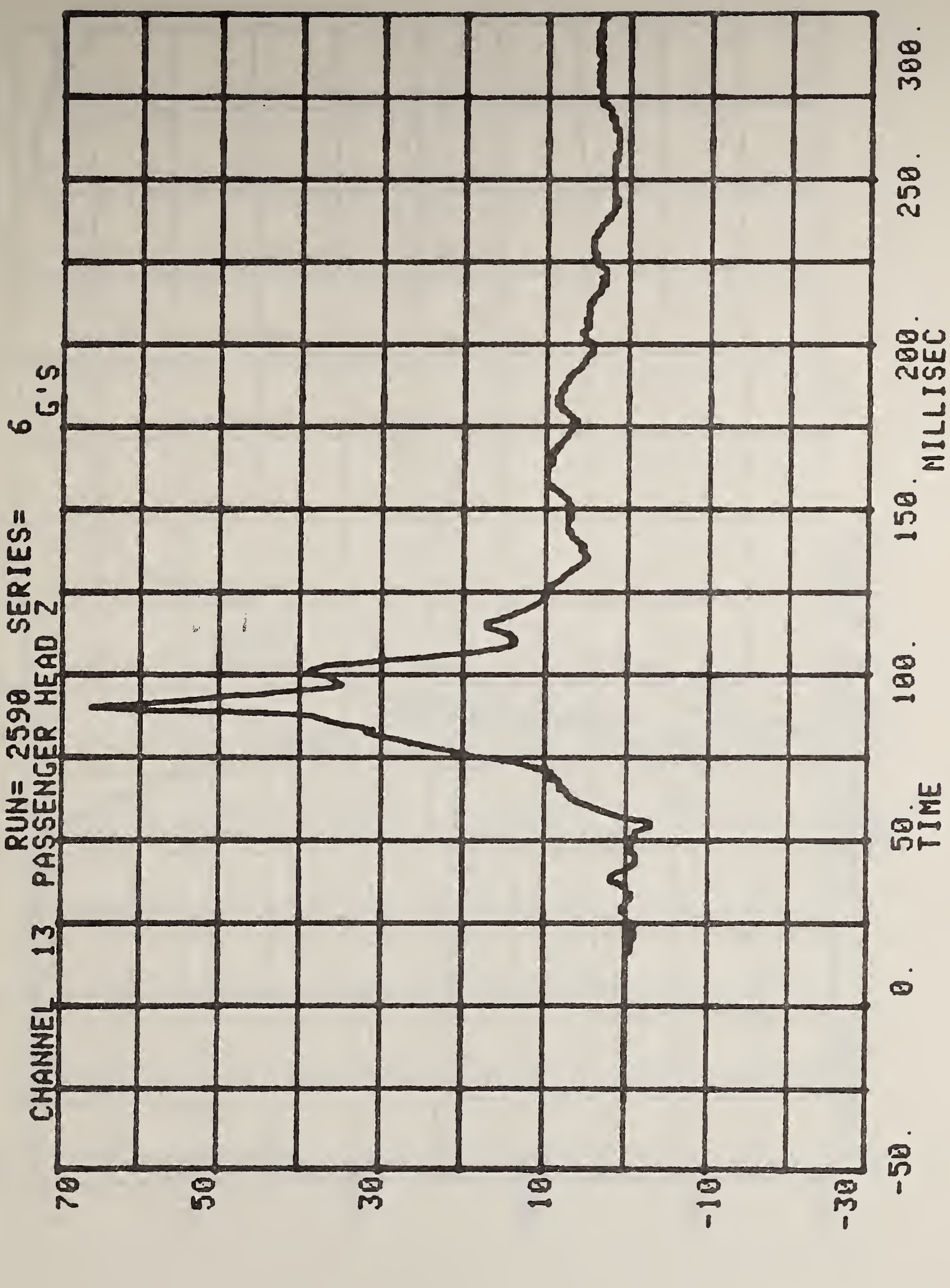
AVERAGE ACCELERATION BETWEEN T1 AND T2= 36.8G'S

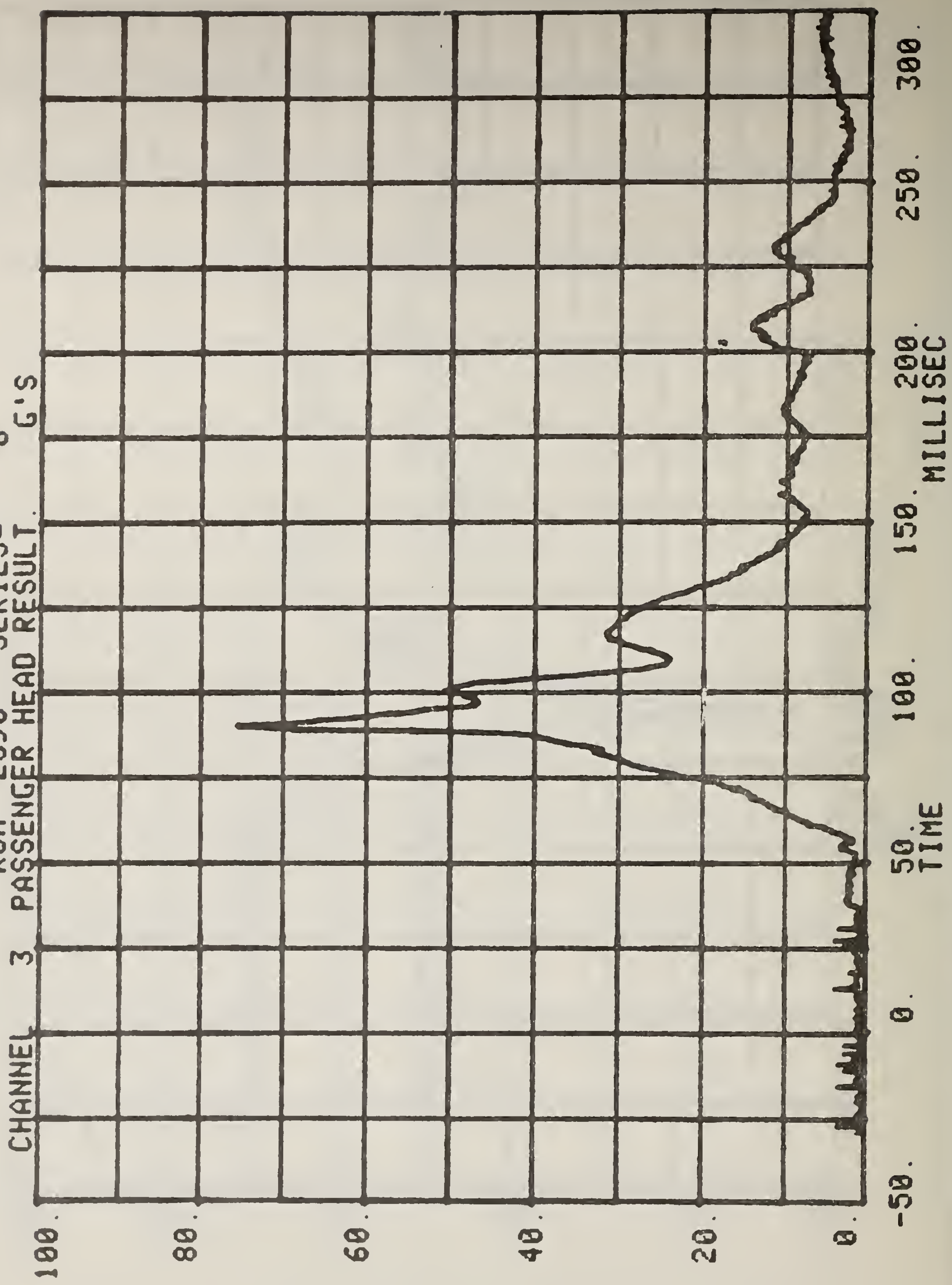
EVENT TIME= 300.0 MSEC

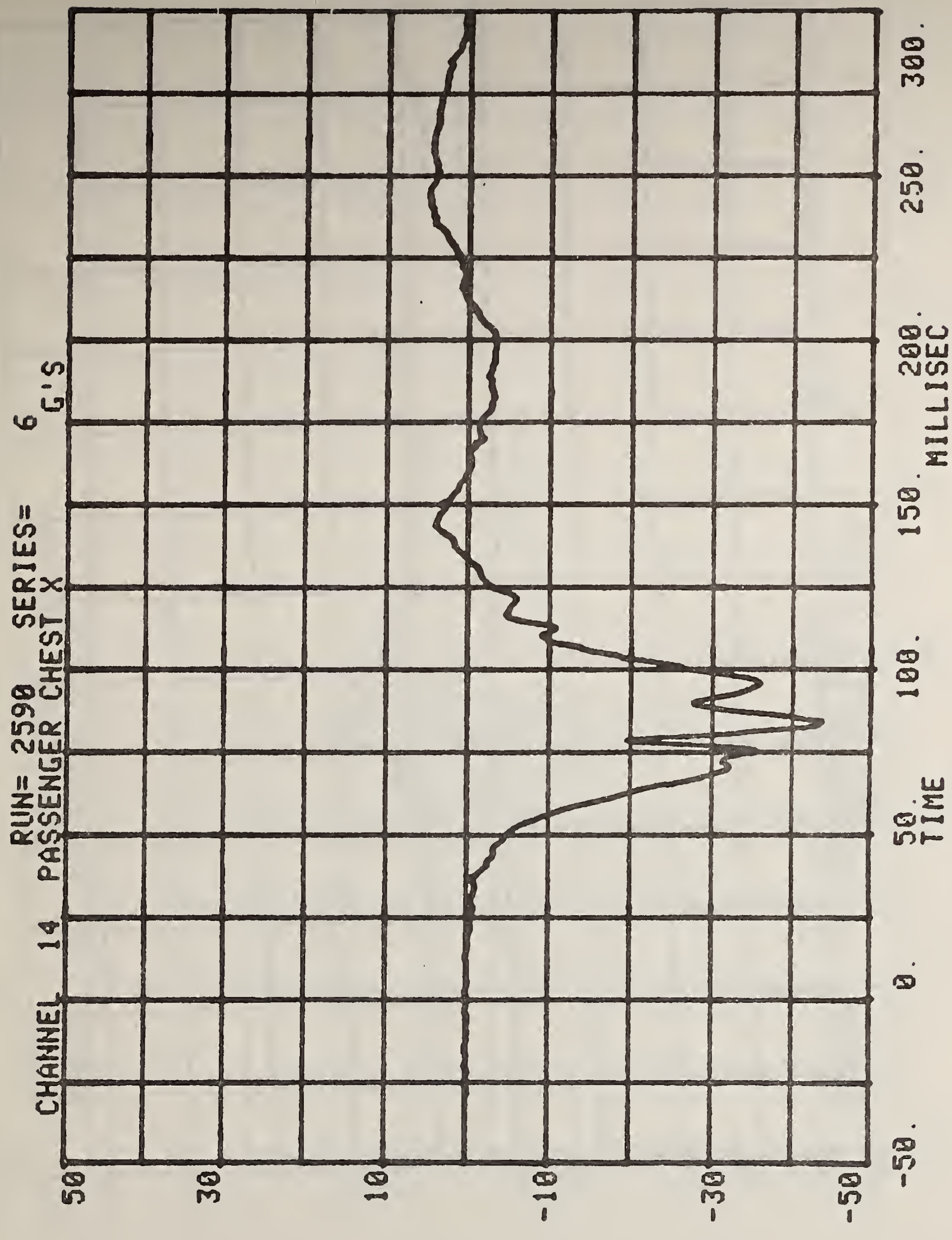
SEVERITY INDEX= 615.1

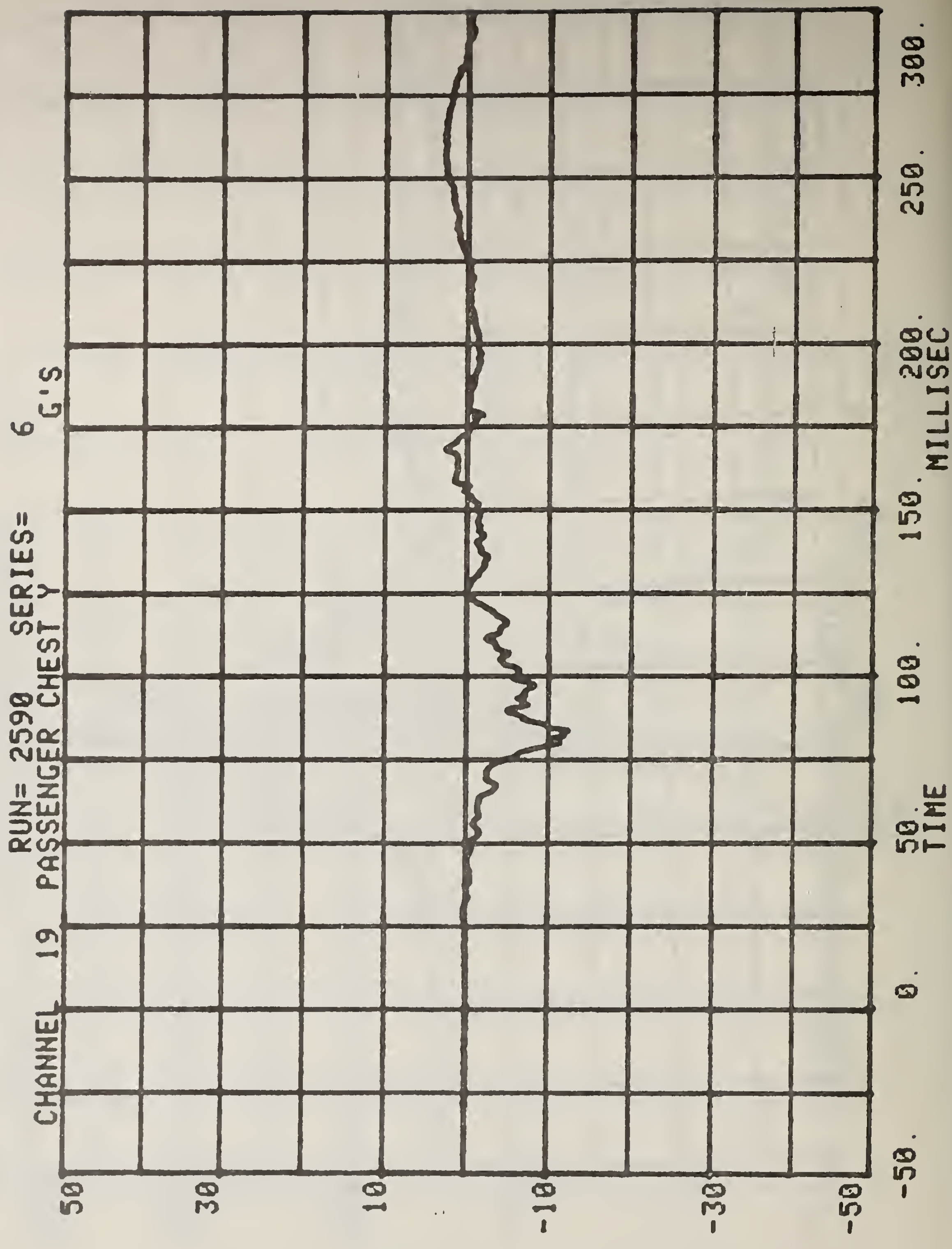

RUN= 2590 SERIES= 6
CHANNEL 11 PASSENGER HEAD X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

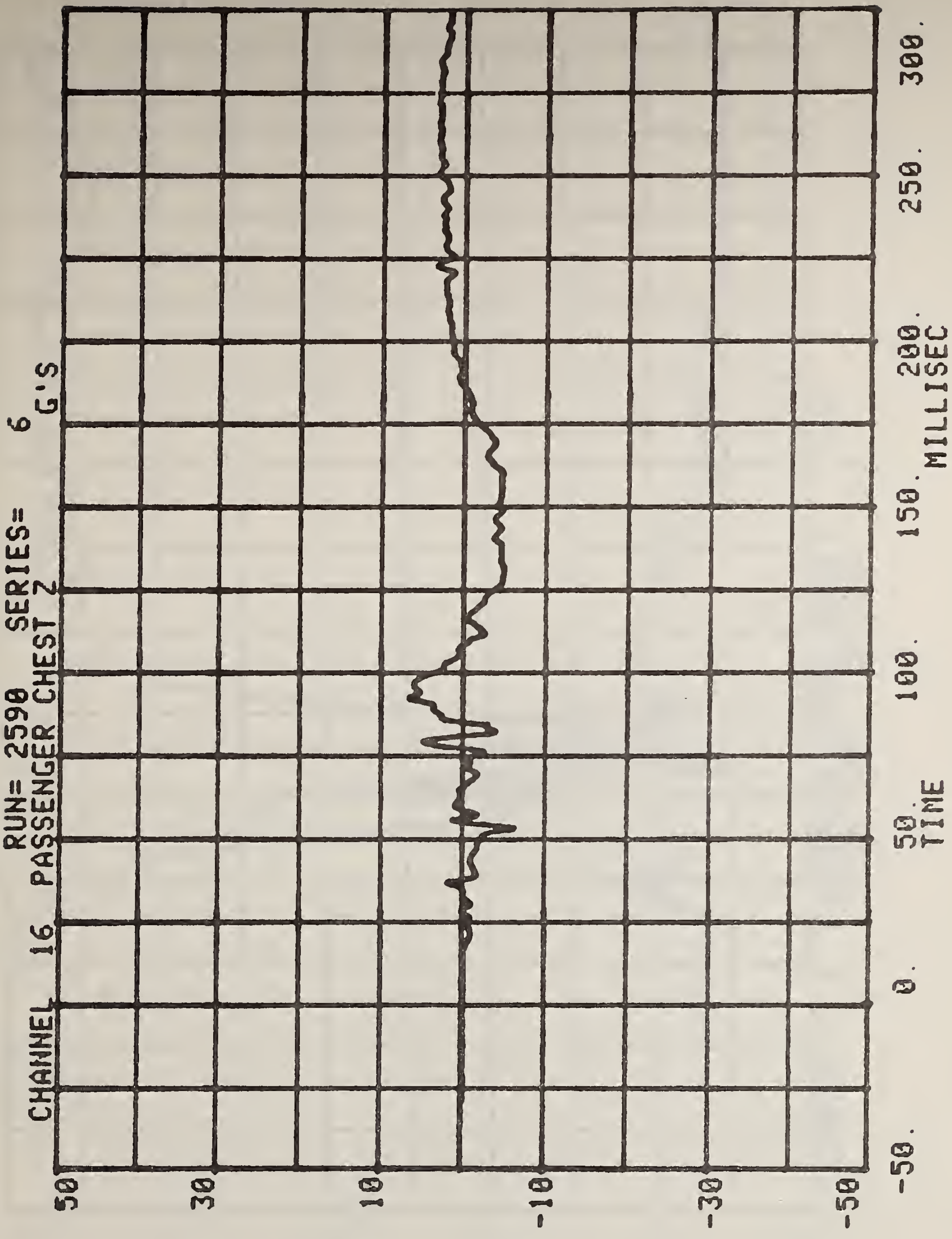

CHANNEL 12 RUN= 2590 SERIES= 6
PASSENGER HEAD Y
G'S
TIME MILLISEC
-50. 0. 50. 100. 150. 200. 250. 300.
50
30
10
-10
-30
-50

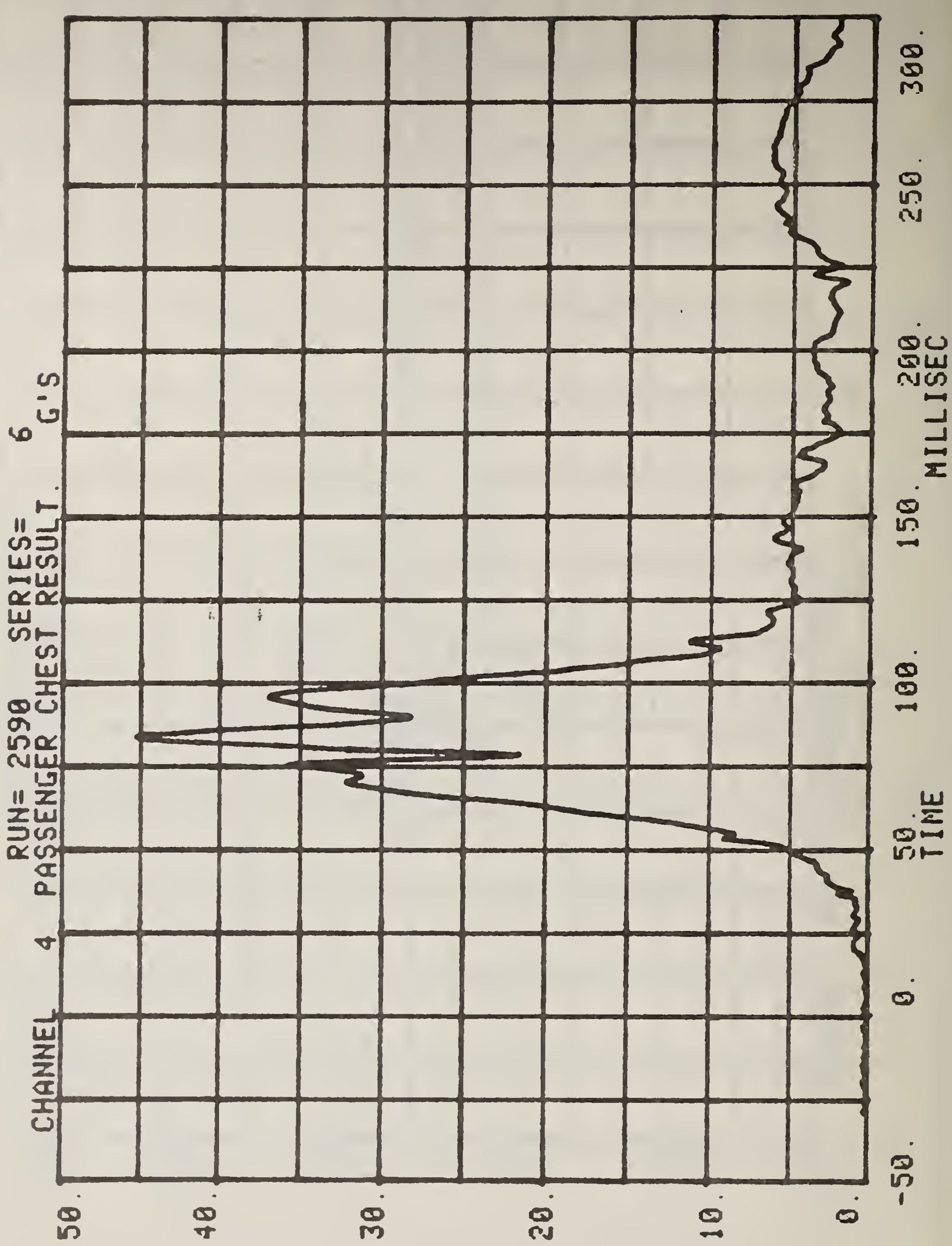

CHANNEL 13 RUN= 2590 SERIES= 6
PASSENGER HEAD Z
G'S
70
50
30
10
-10
-30
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

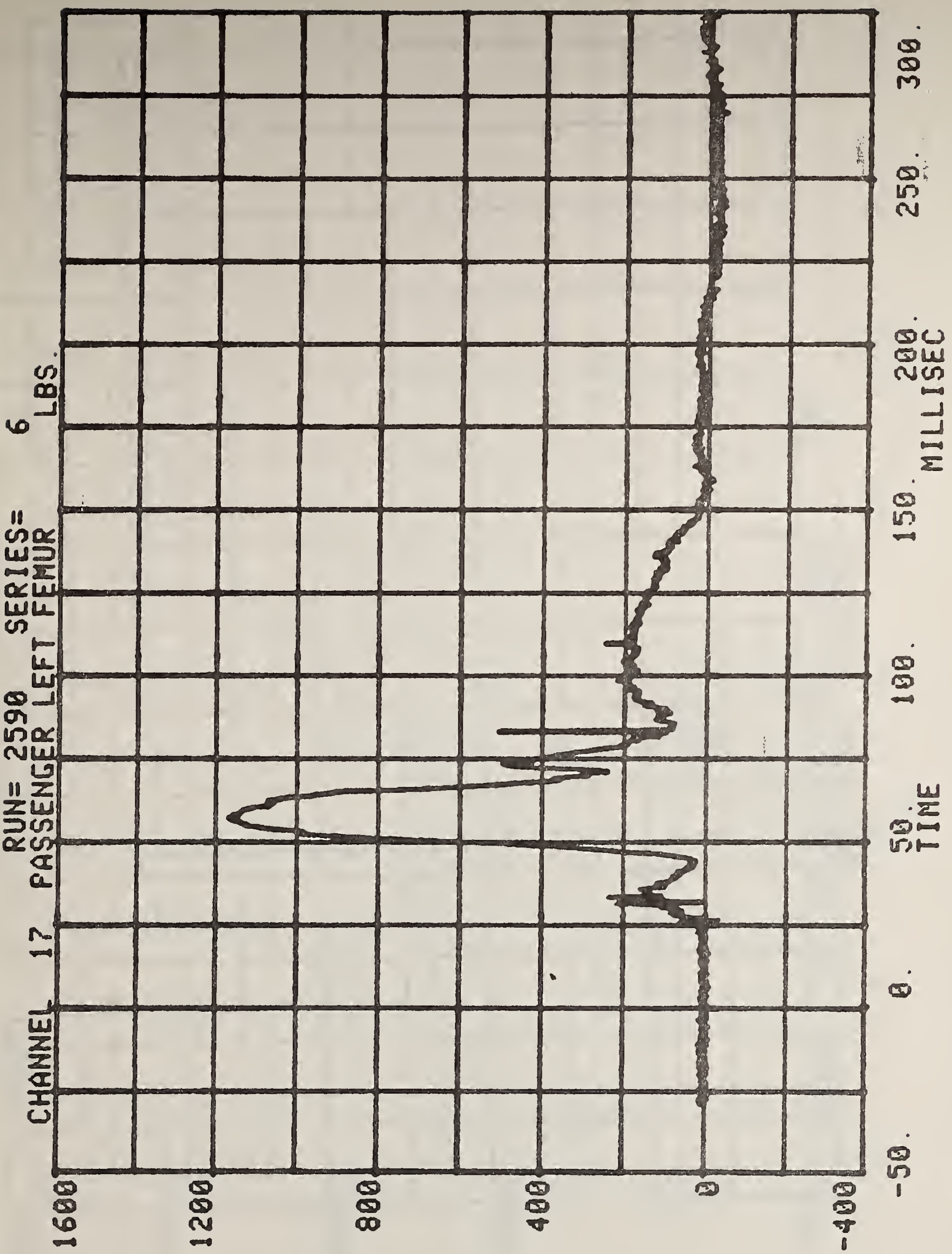

CHANNEL 3 RUN= 2590 SERIES= 6
PASSENGER HEAD RESULT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 14 RUN= 2590 SERIES= 6
PASSENGER CHEST X G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

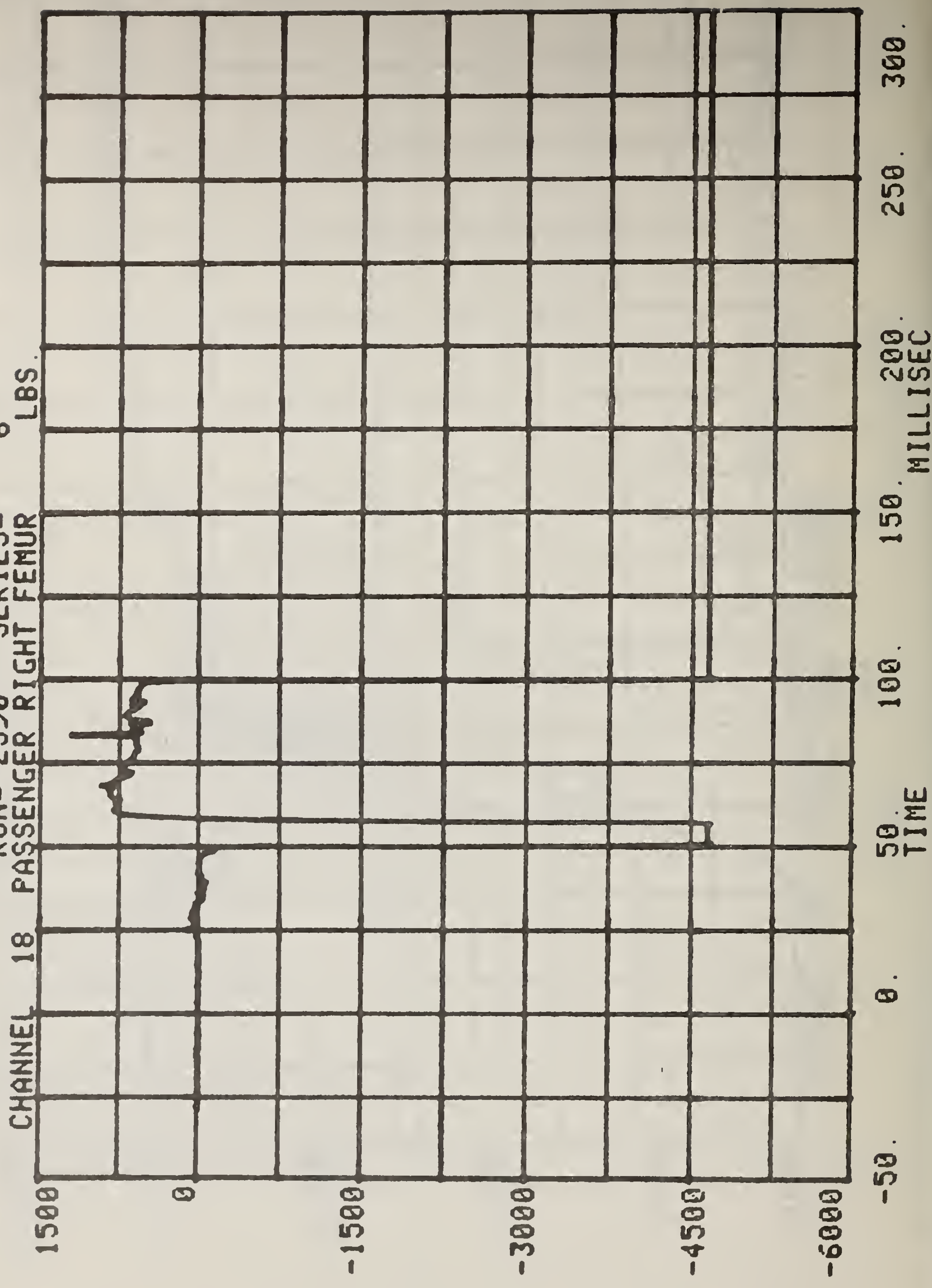

CHANNEL 19 RUN= 2590 SERIES= 6
PASSENGER CHEST Y
G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

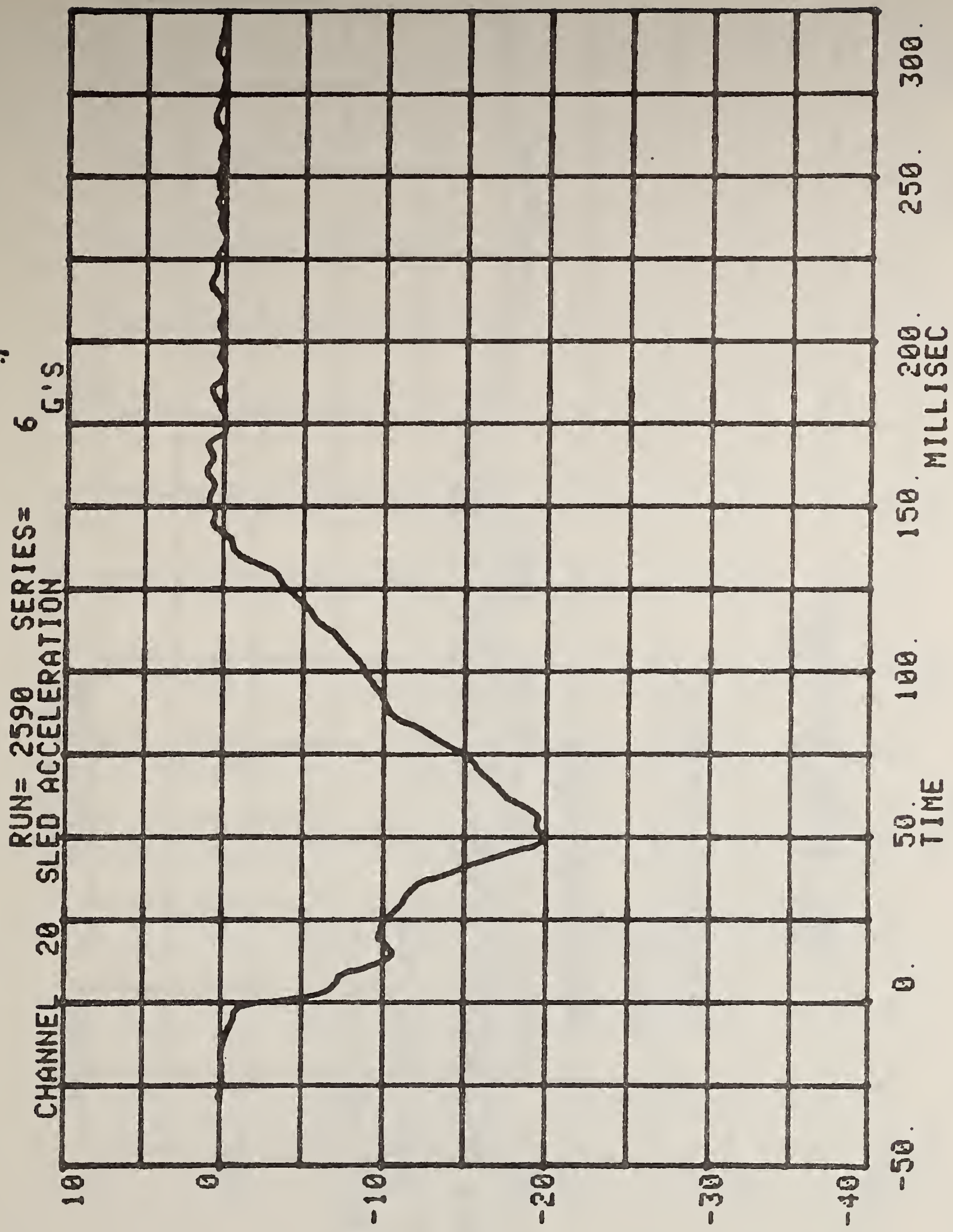

CHANNEL 16 RUN= 2590 SERIES= 6
PASSENGER CHEST Z G'S
50
30
10
-10
-30
-50
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 4 RUN= 2590 SERIES= 6
PASSENGER CHEST RESULT. G'S
50.
40.
30.
20.
10.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



CHANNEL 17 RUN= 2590 SERIES= 6
PASSENGER LEFT FEMUR
LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 18 RUN= 2590 SERIES= 6
PASSENGER RIGHT FEMUR LBS.
1500
0
-1500
-3000
-4500
-6000
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 20 RUN= 2590 SERIES= 6
SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2591

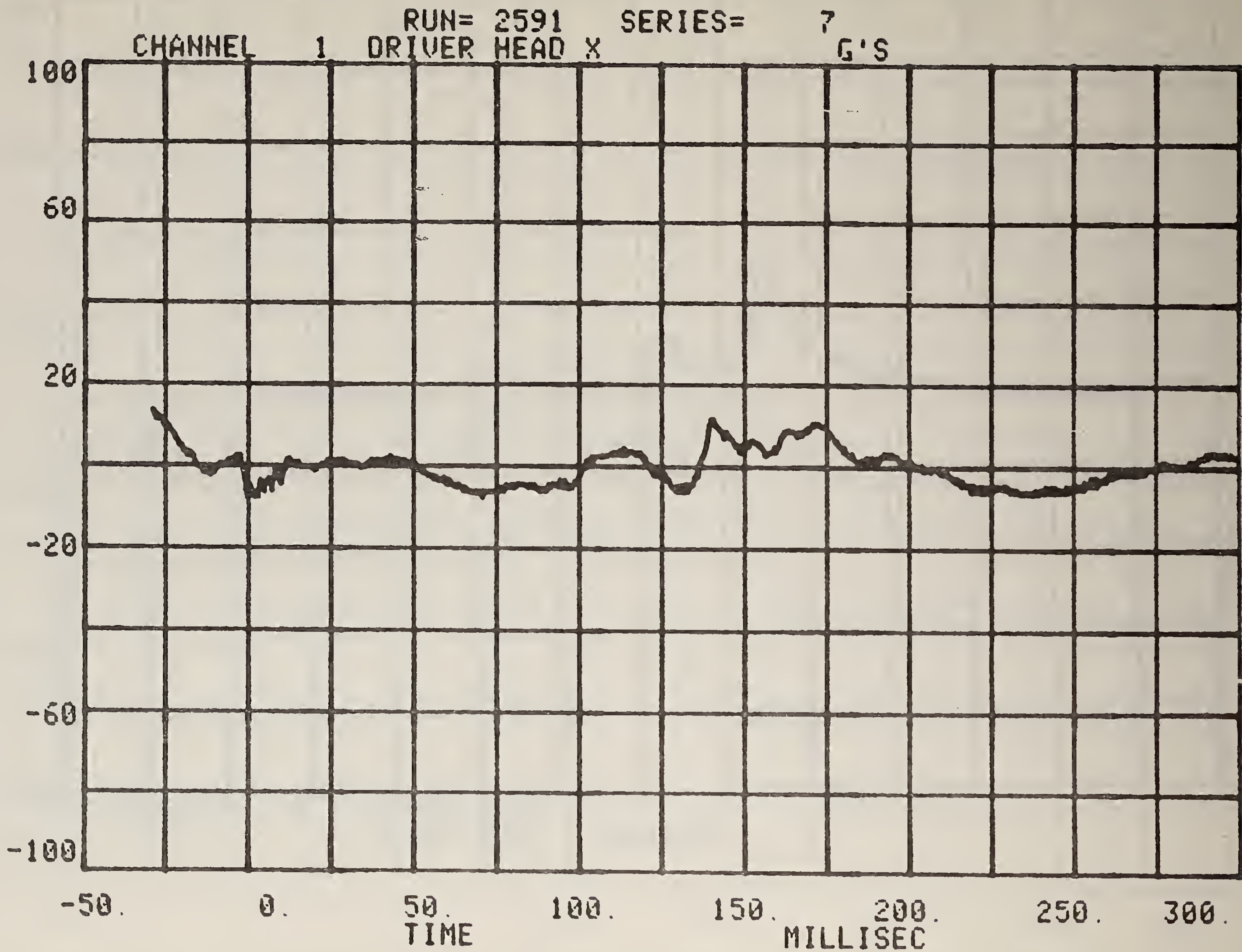
DRIVER HEAD RESULT.

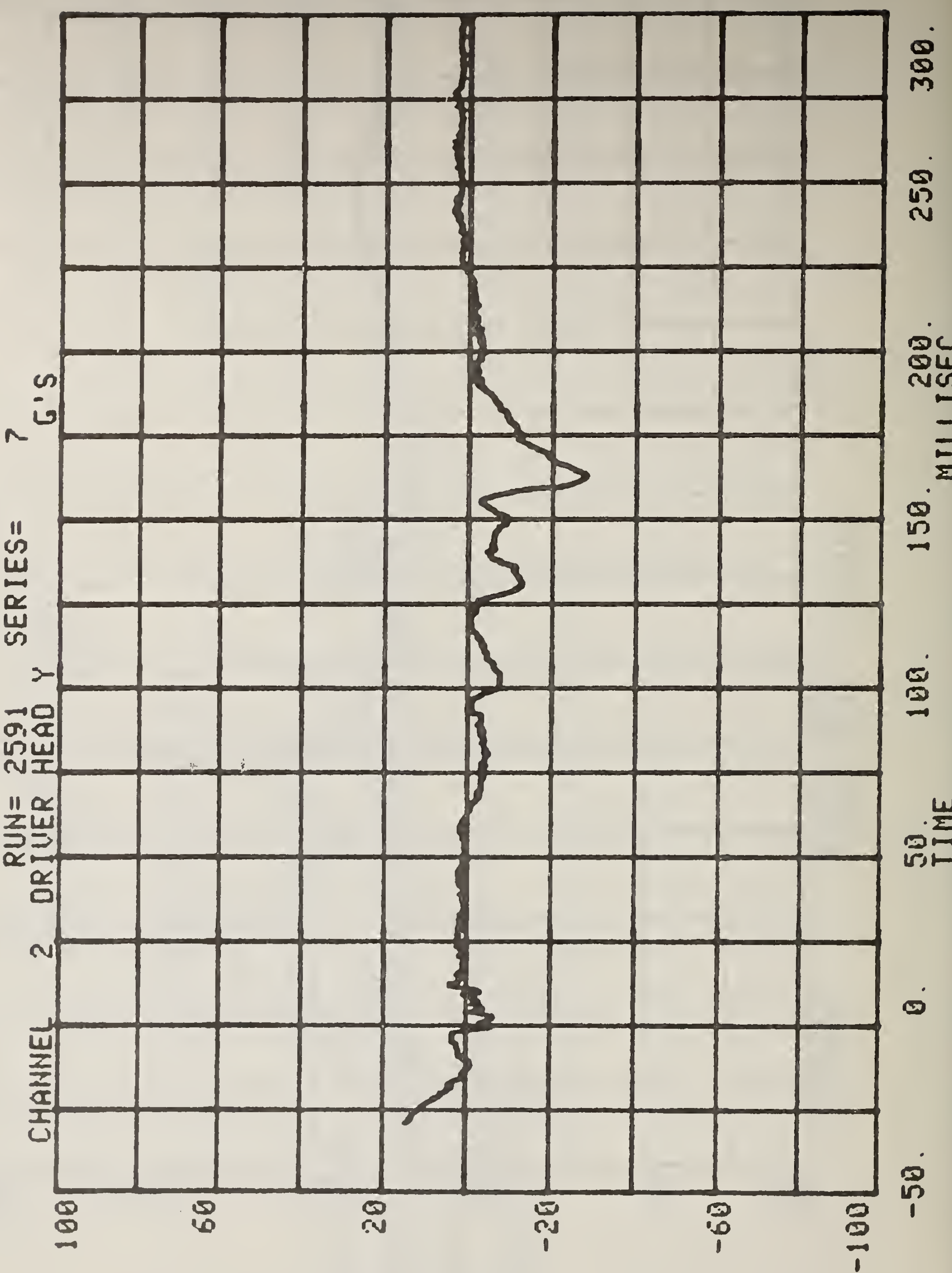
HIC= 143.5   FROM T1= .07080   TO T2= .18150

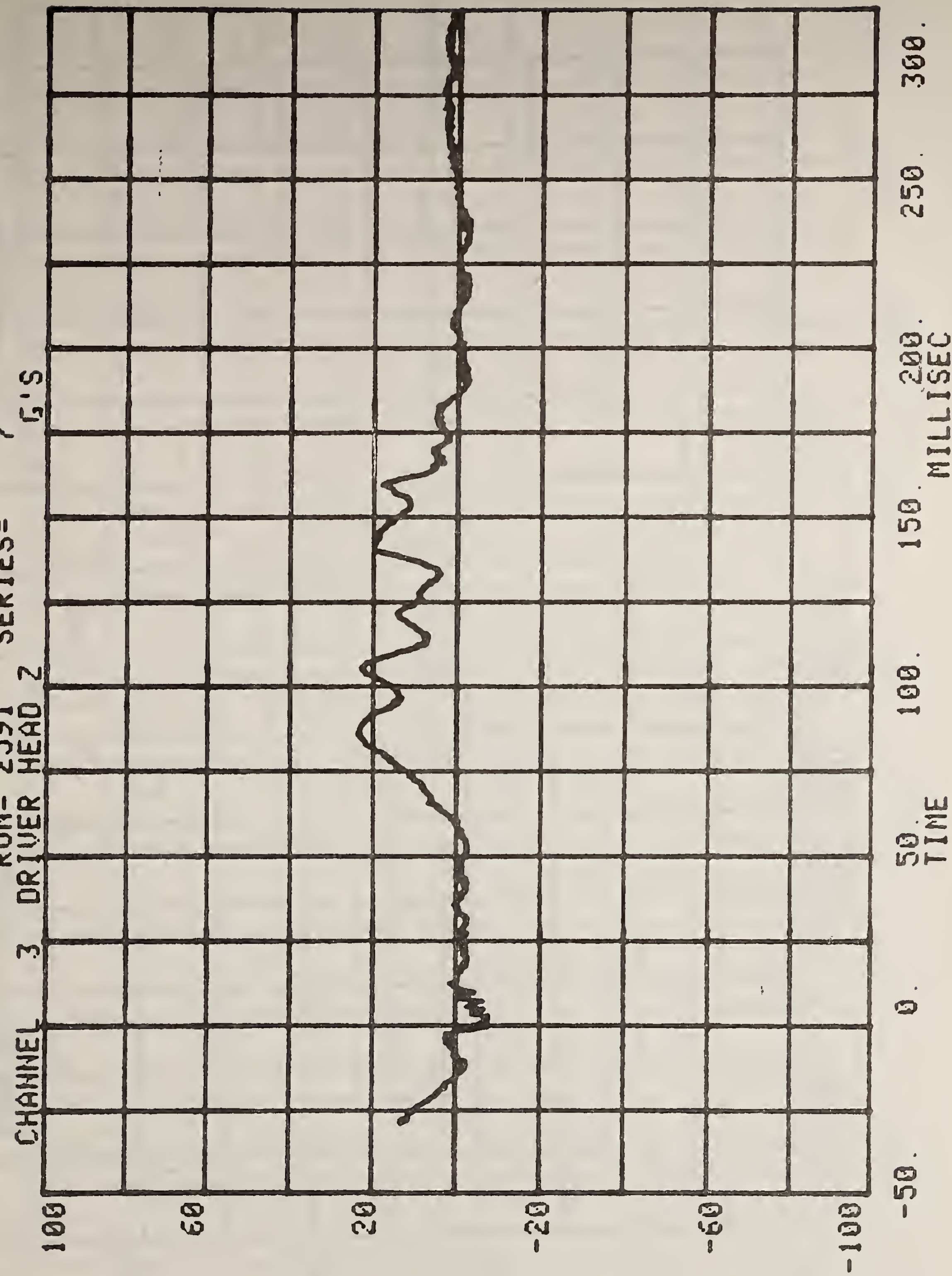
AVERAGE ACCELERATION BETWEEN T1 AND T2= 17.6G'S

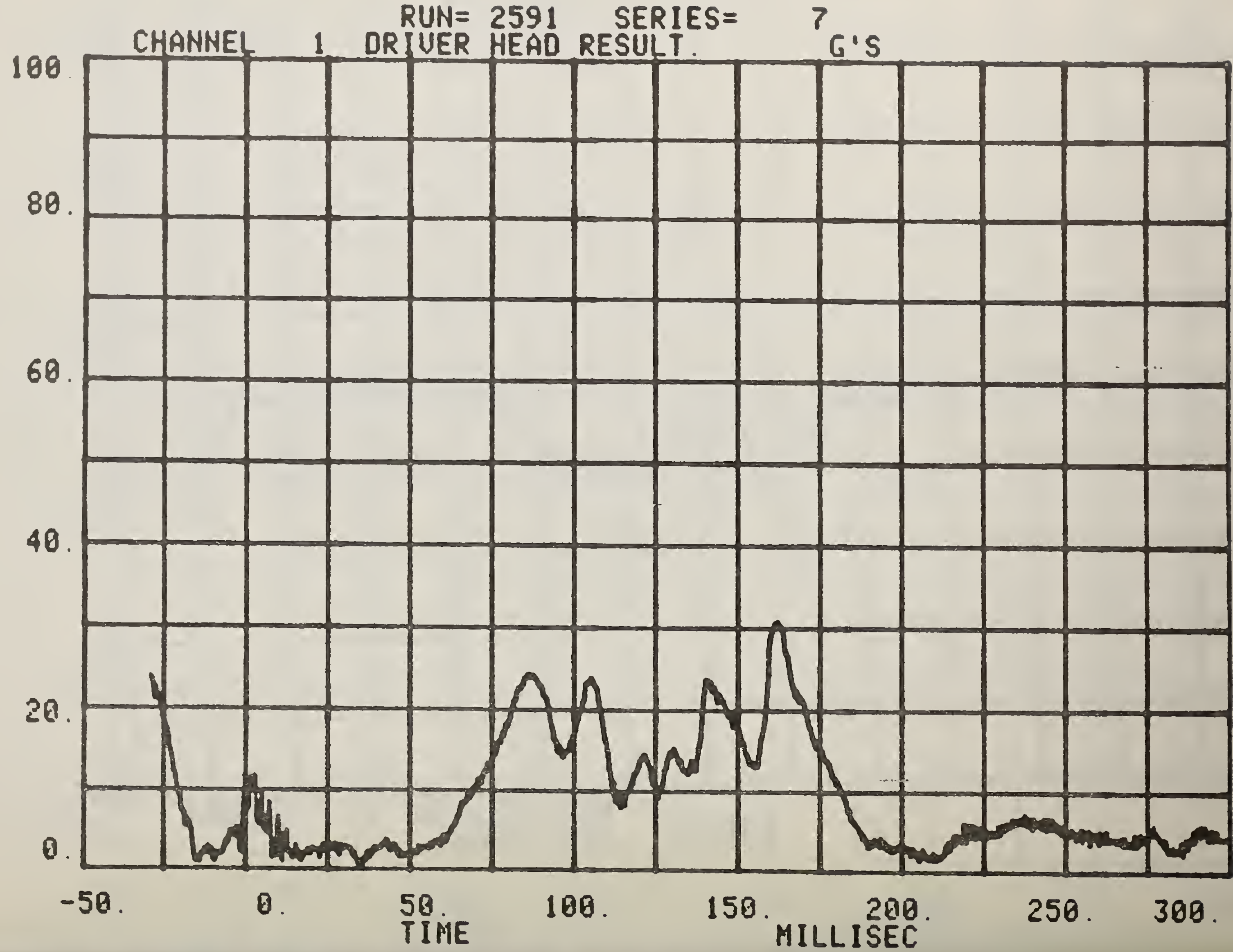
EVENT TIME= 300.0 MSEC

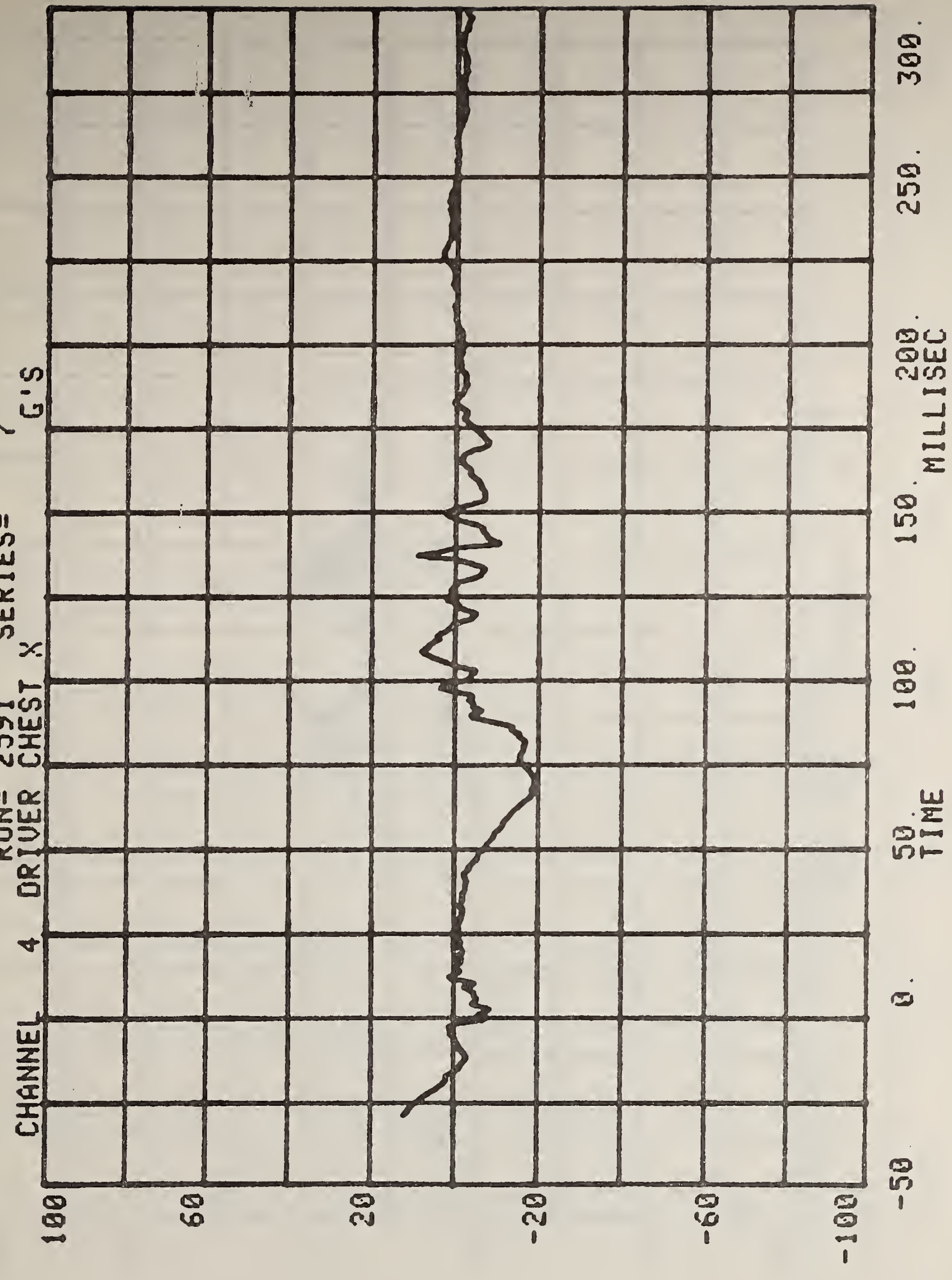
SEVERITY INDEX= 177.5

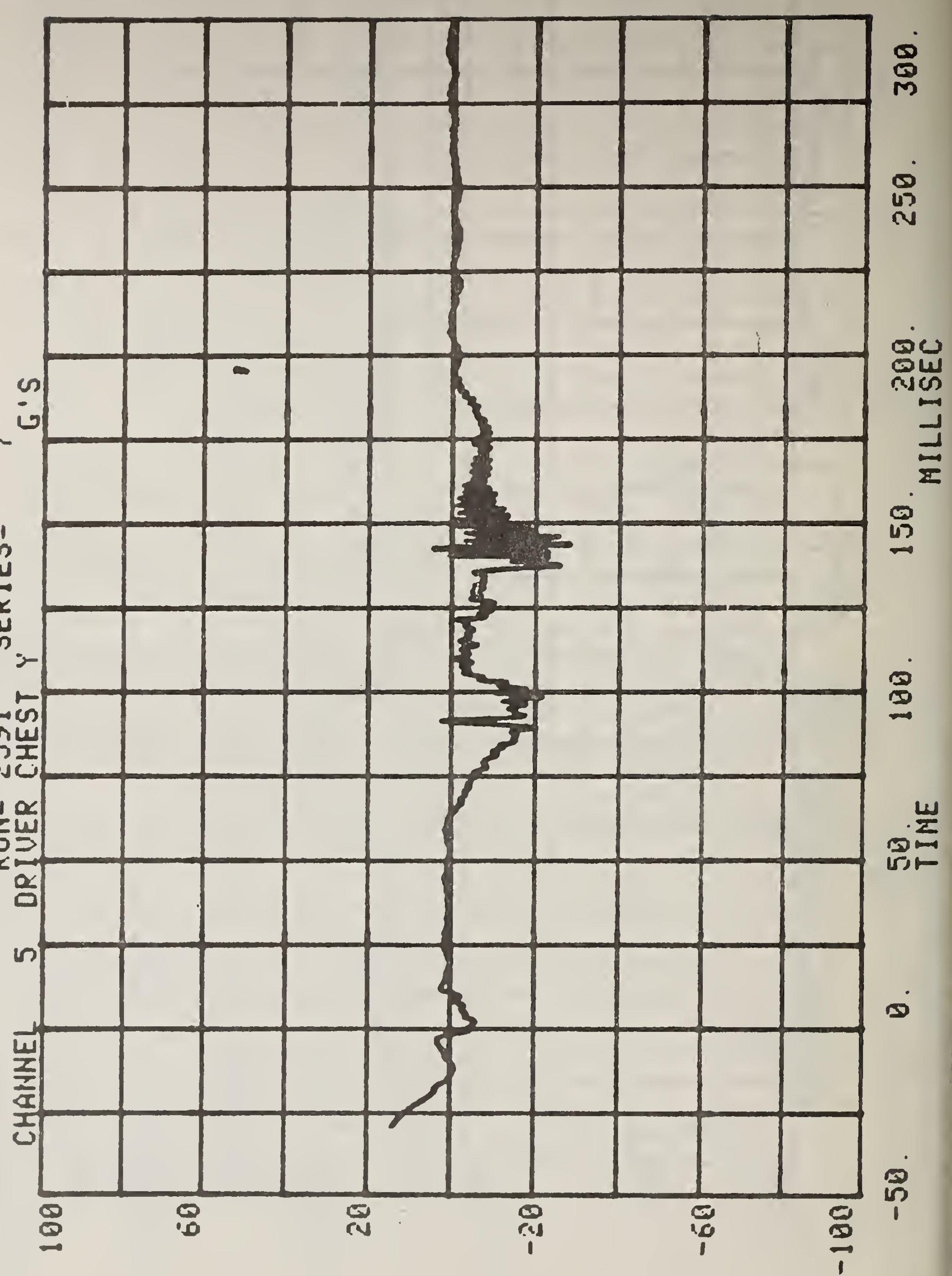

RUN= 2591 SERIES= 7
CHANNEL 1 DRIVER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

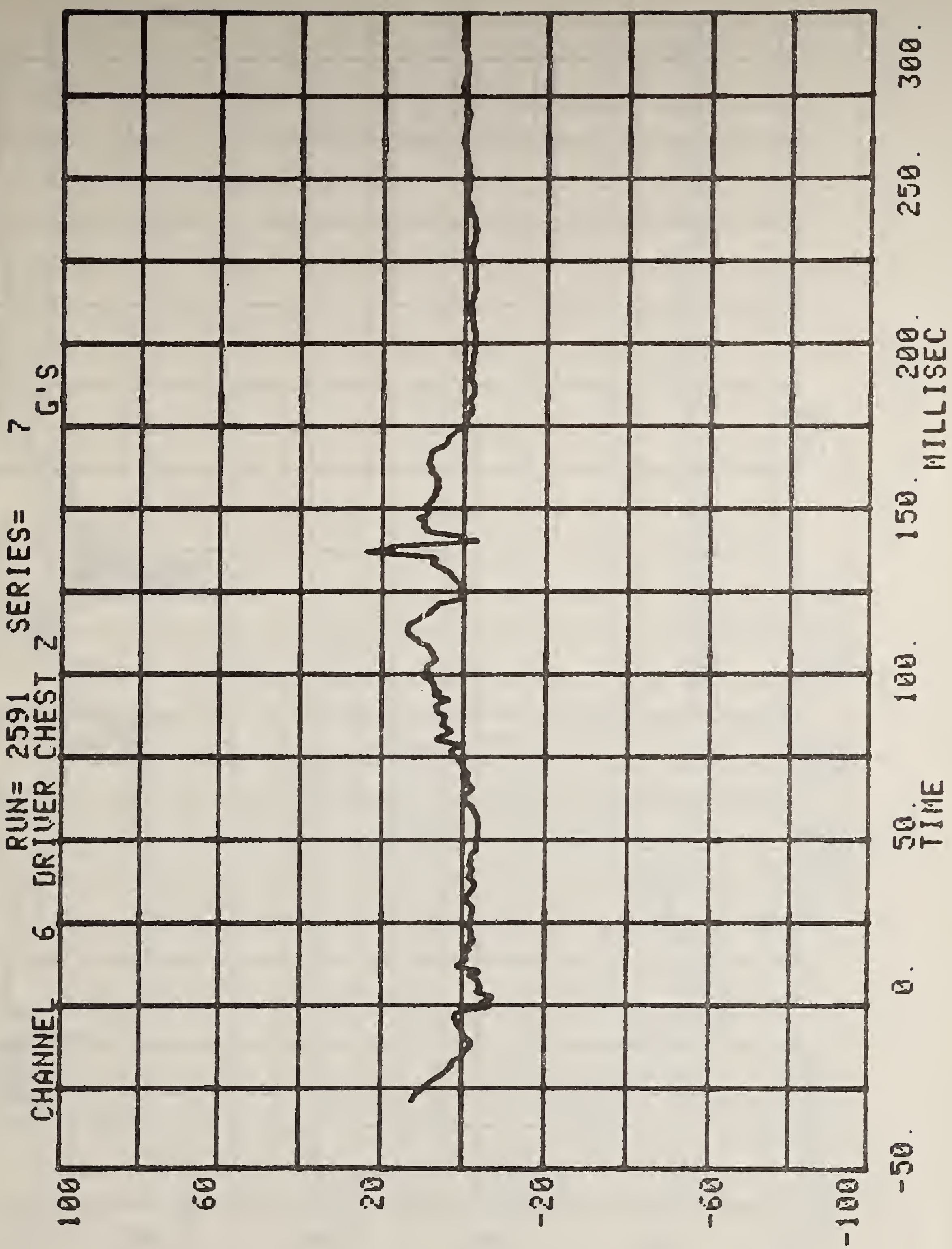

CHANNEL 2 RUN= 2591 SERIES= 7
DRIVER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 3 RUN= 2591 SERIES= 7
DRIVER HEAD 2 G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

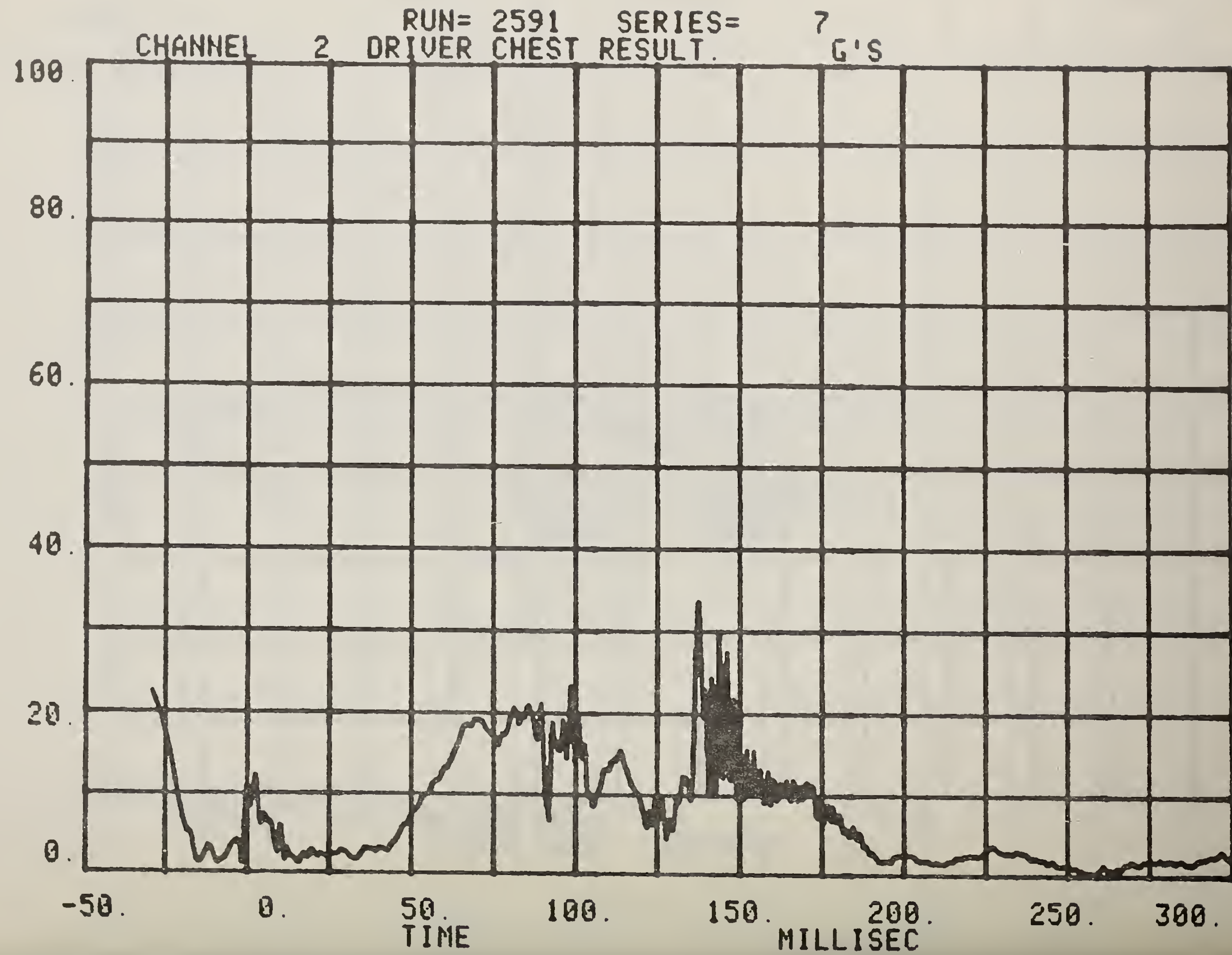

RUN= 2591 SERIES= 7
CHANNEL 1 DRIVER HEAD RESULT. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

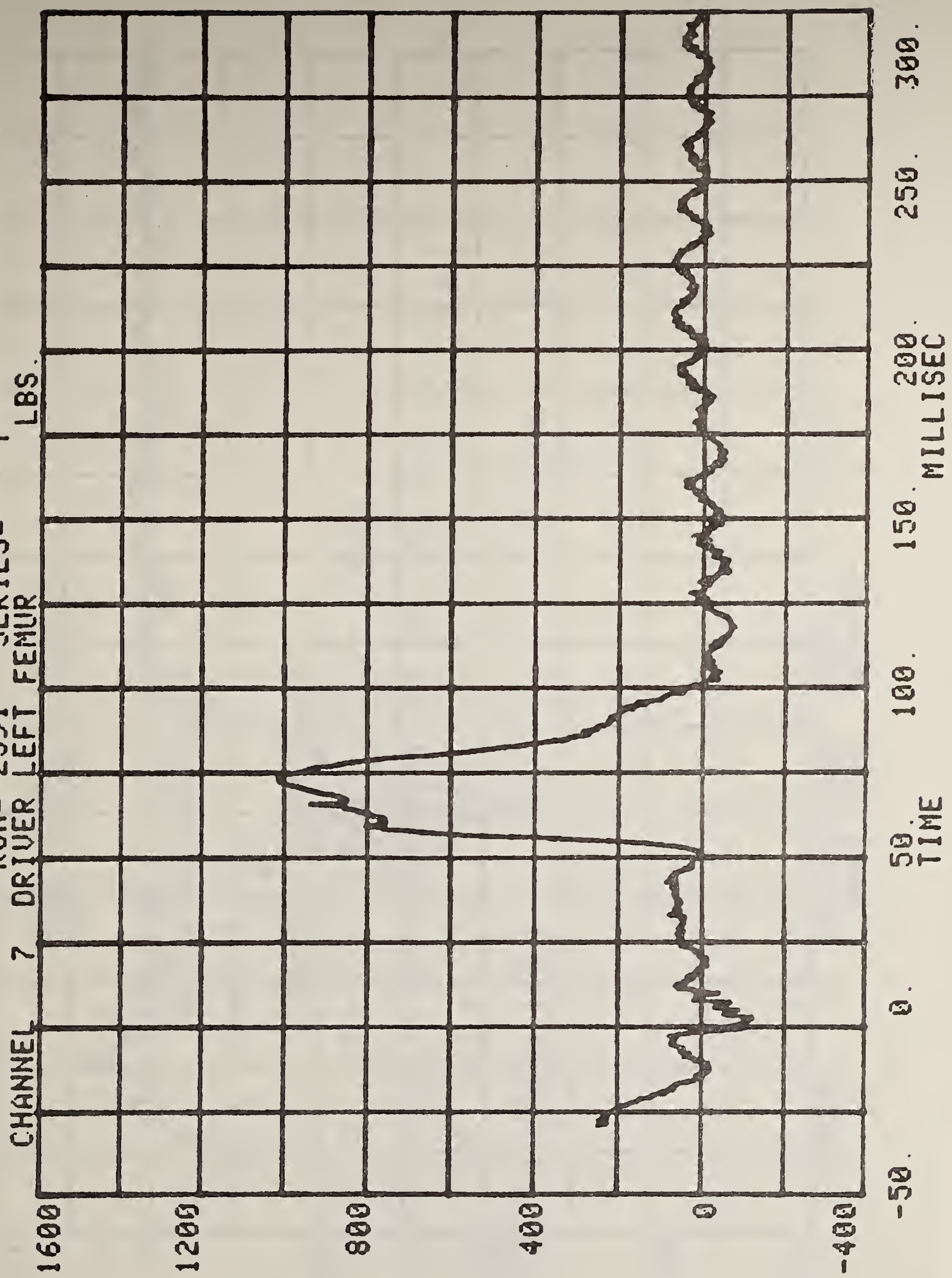

CHANNEL 4 RUN= 2591 SERIES= 7
DRIVER CHEST X G'S
100
60
20
-20
-60
-100
-50
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

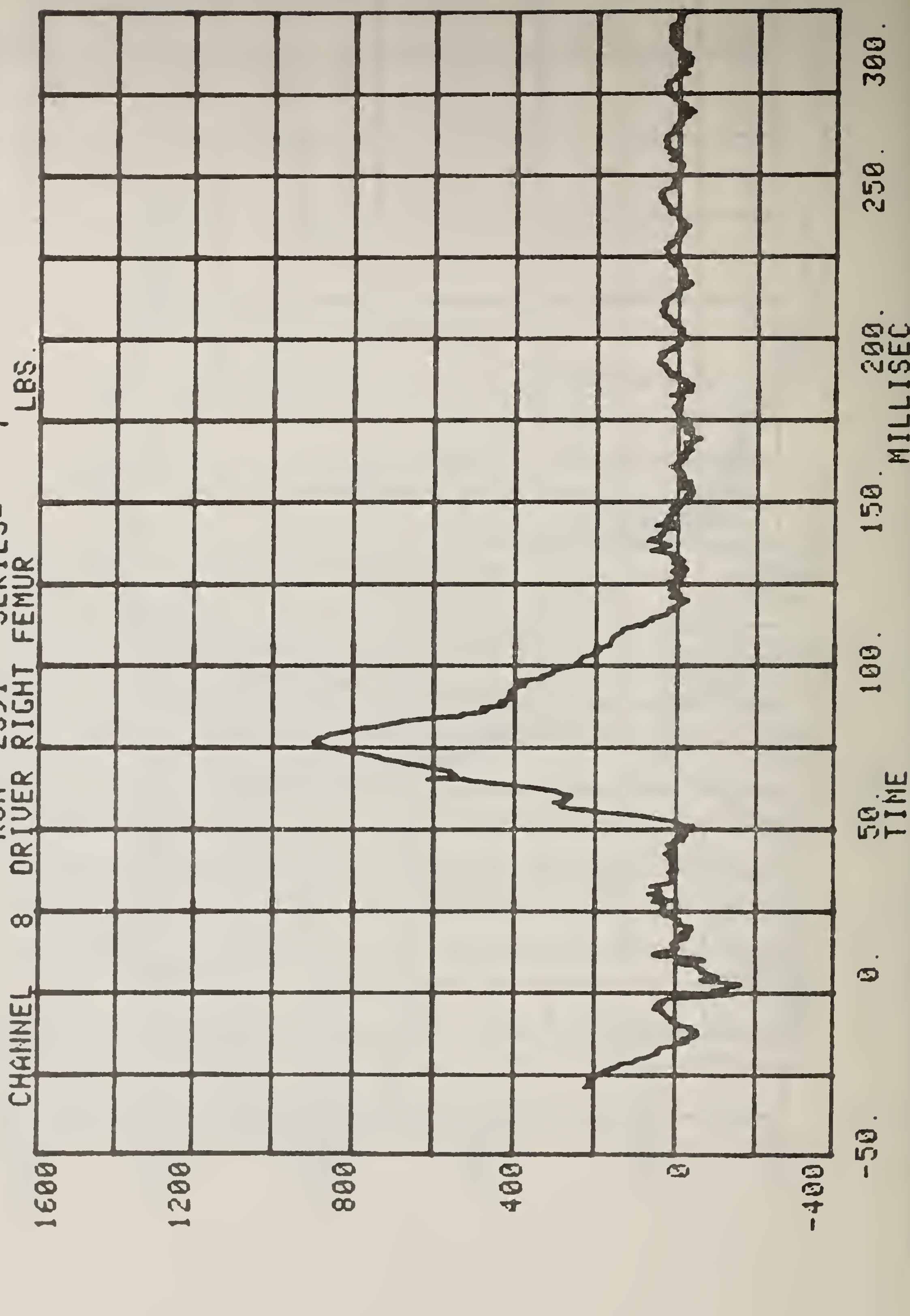

CHANNEL 5 RUN= 2591 SERIES= 7
DRIVER CHEST Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC



CHANNEL 6 RUN= 2591 SERIES= 7
DRIVER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2591 SERIES= 7
CHANNEL 2 DRIVER CHEST RESULT. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 7 RUN= 2591 SERIES= 7
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50. 0. 50. 100. 150. 200. 250. 300.
TIME MILLISEC


CHANNEL 8 RUN= 2591 SERIES= 7
DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2591

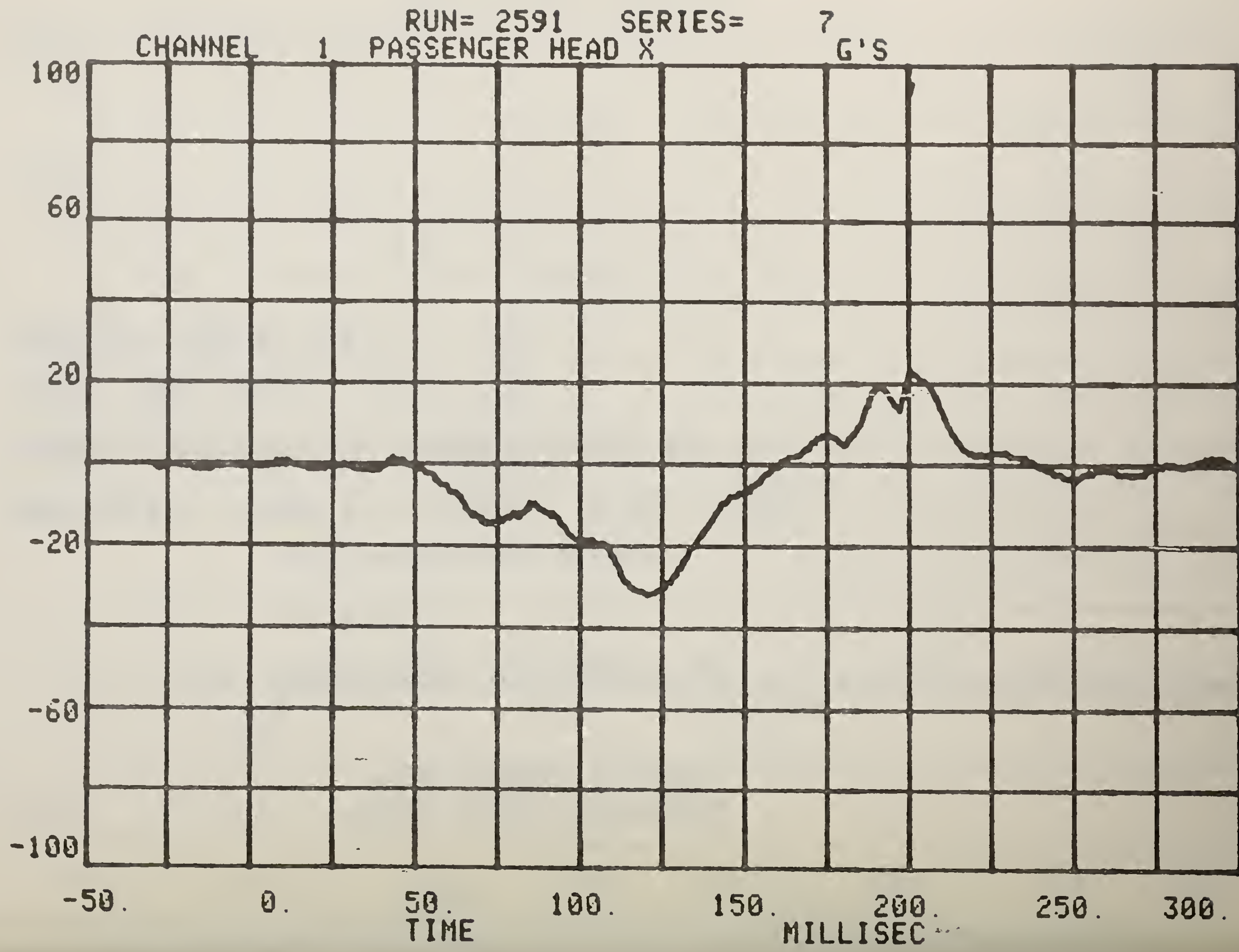
PASSENGER HEAD RESULT.

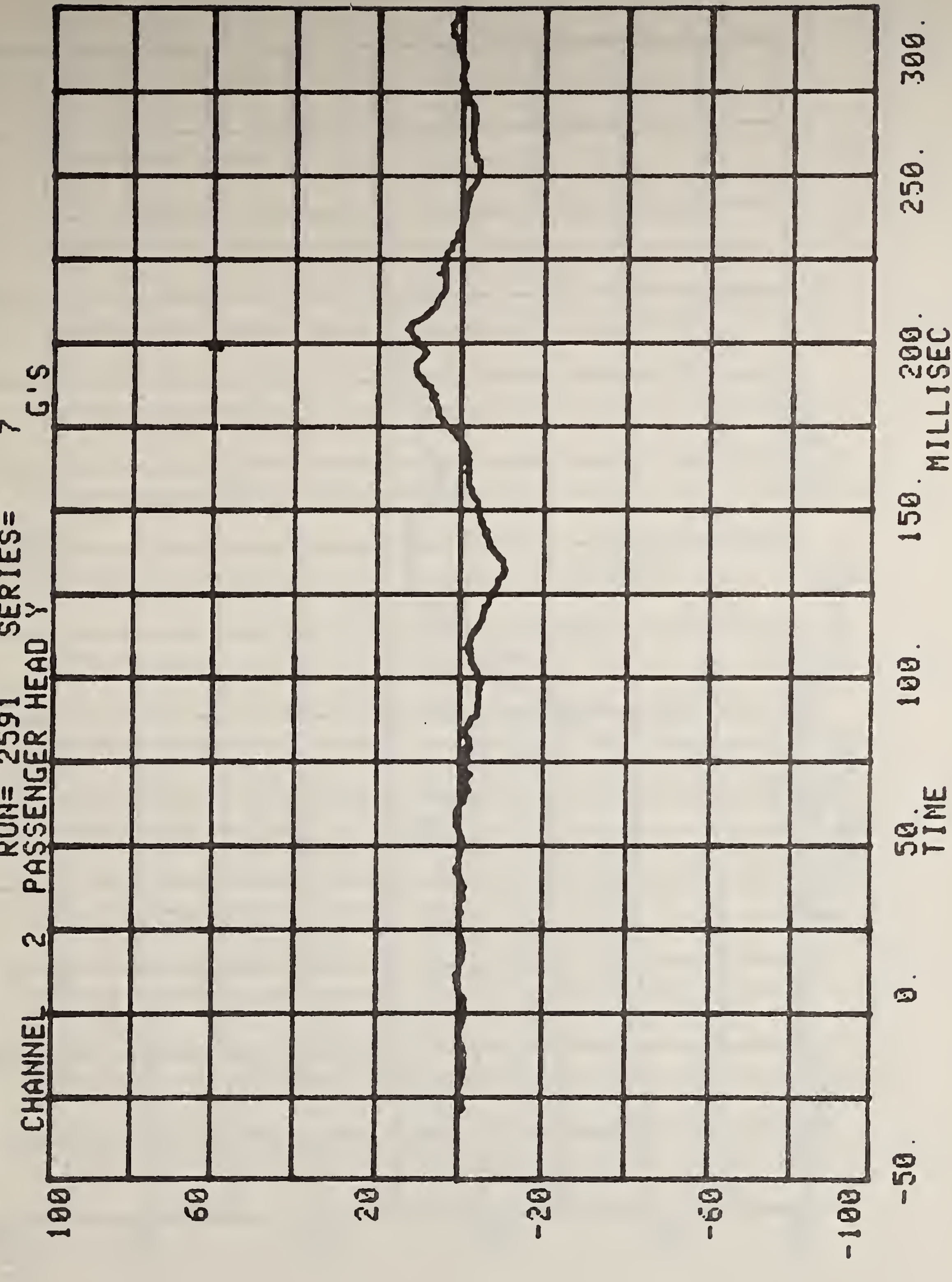
HIC= 469.9   FROM T1= .07200   TO T2= .13620

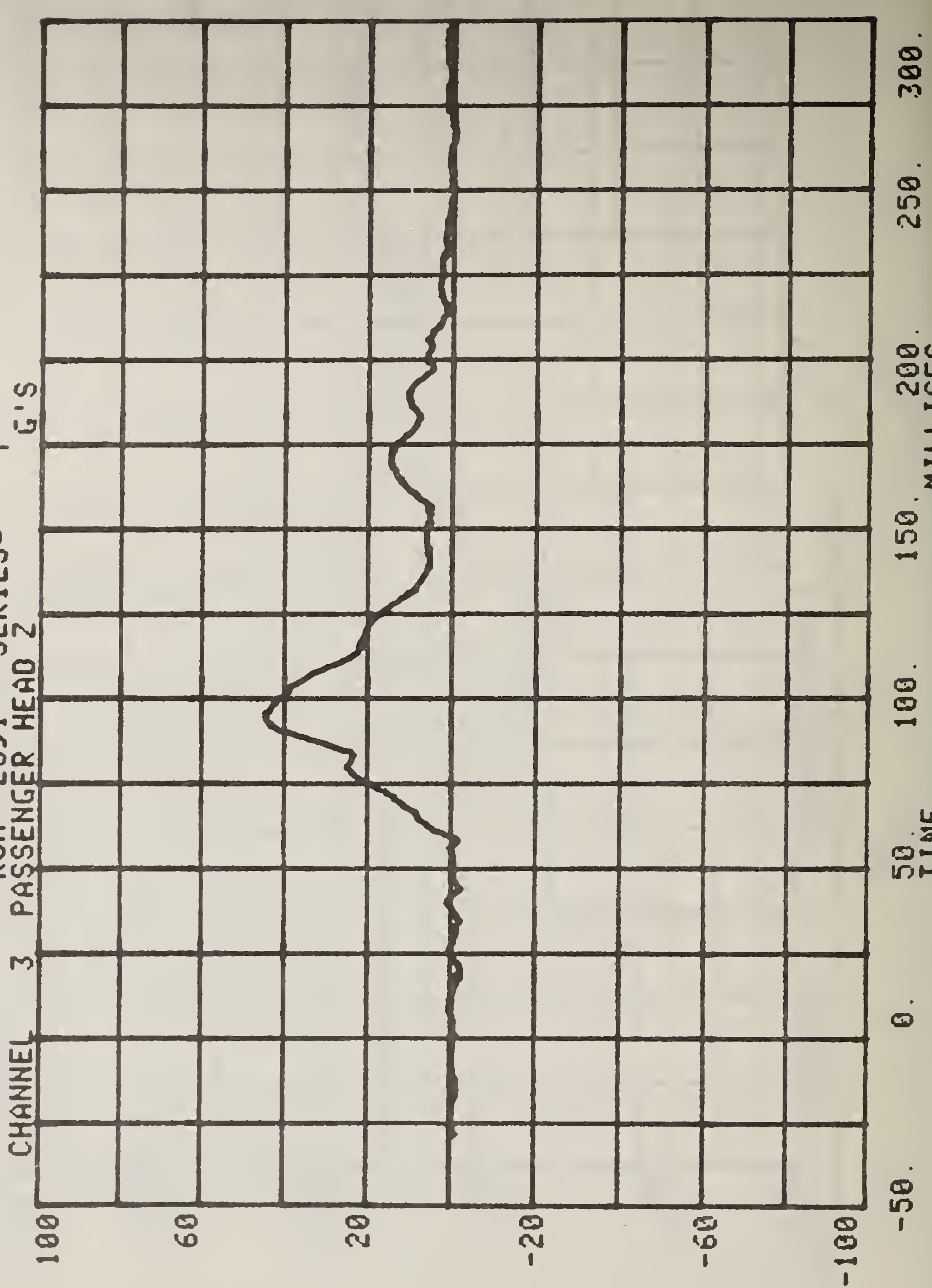
AVERAGE ACCELERATION BETWEEN T1 AND T2= 35.1G'S

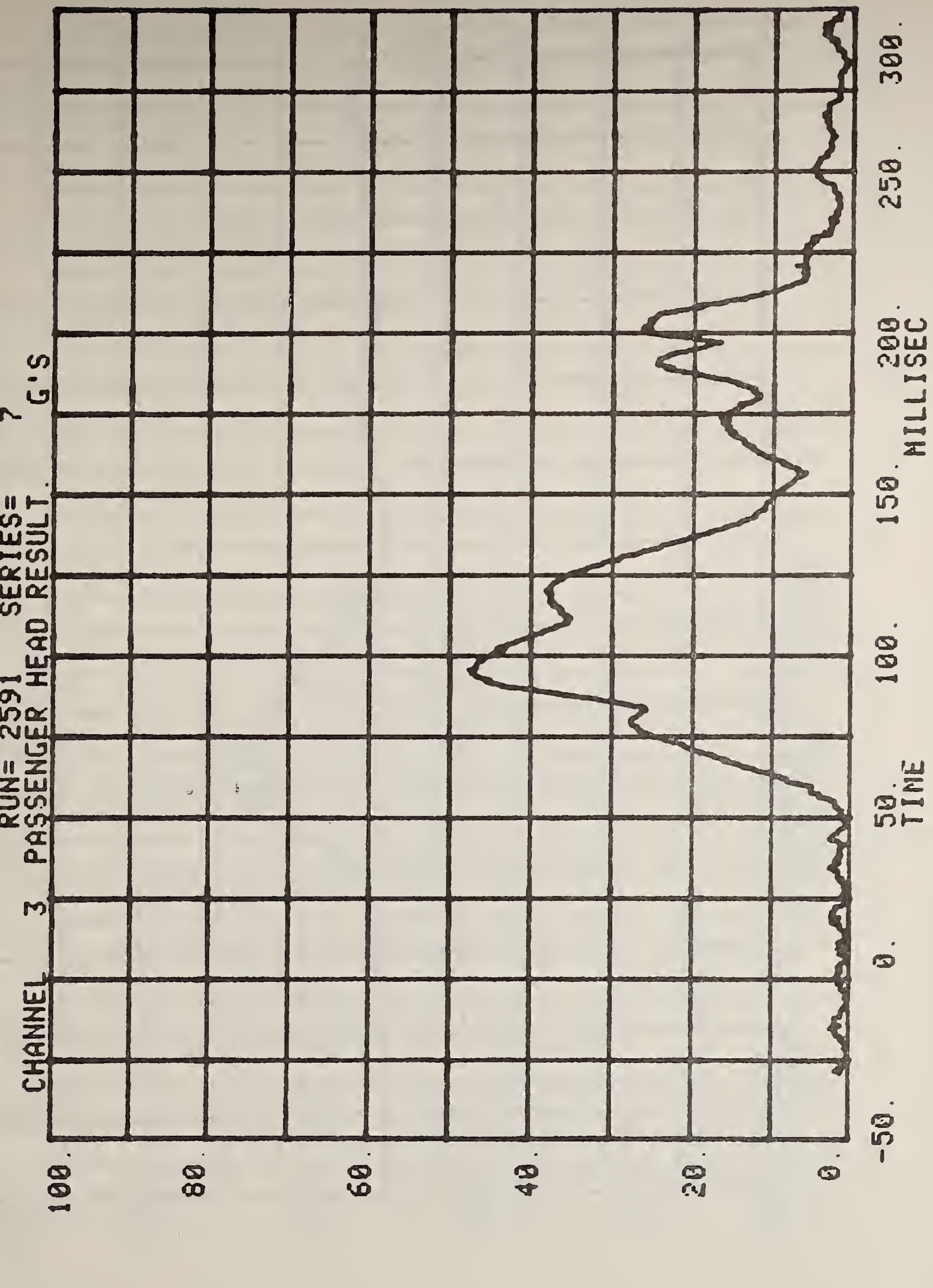
EVENT TIME= 300.0 MSEC

SEVERITY INDEX= 615.5

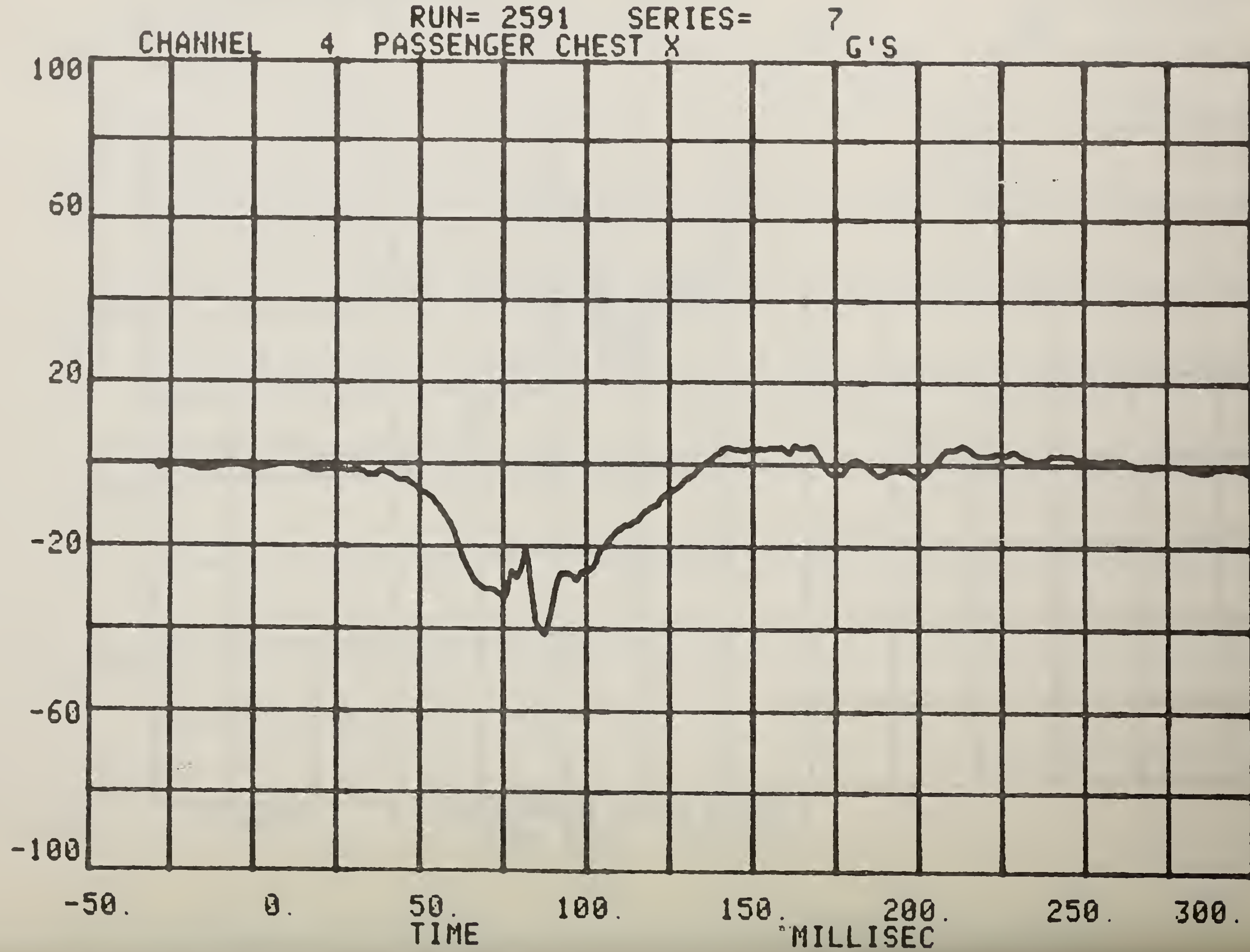

RUN= 2591 SERIES= 7
CHANNEL 1 PASSENGER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

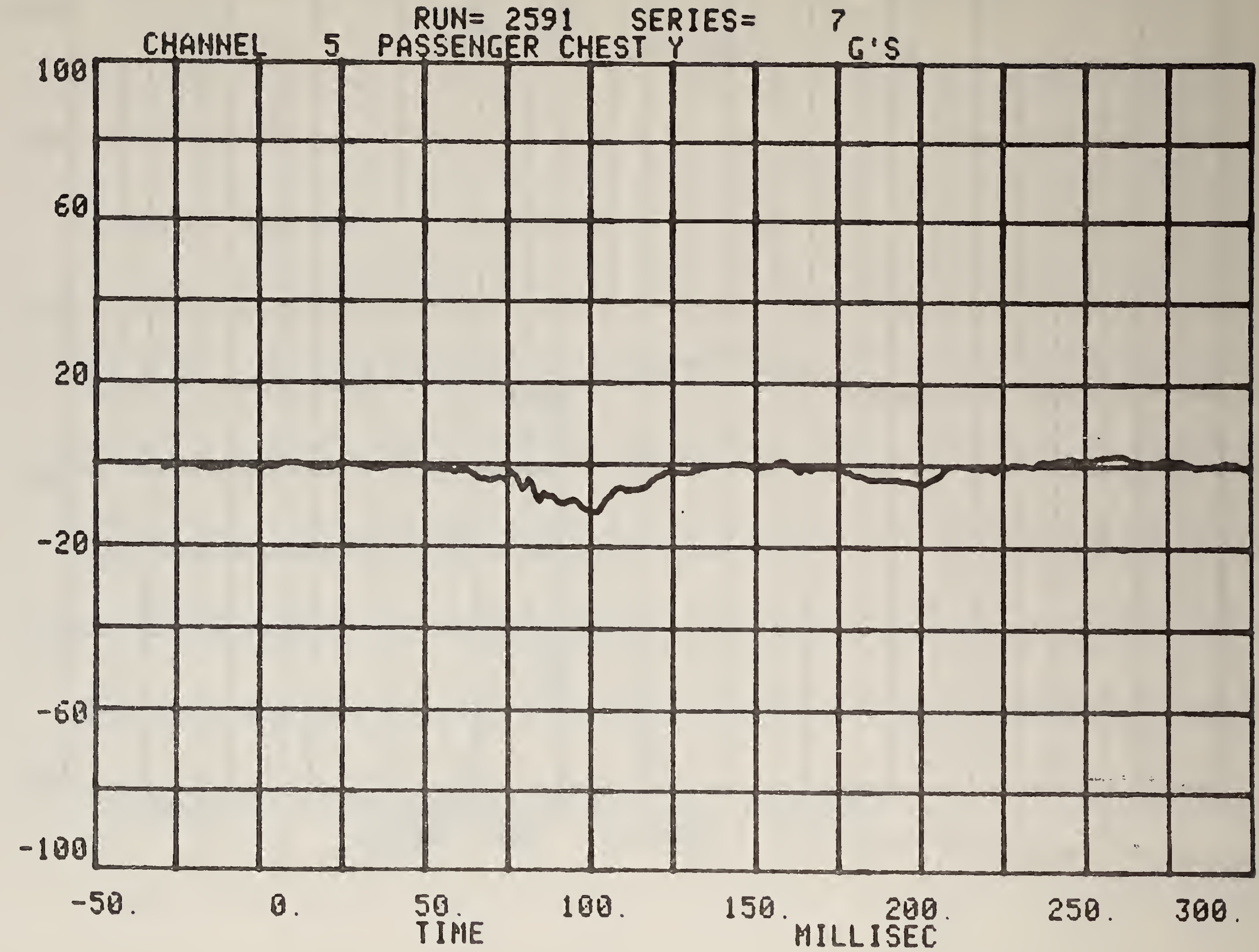

CHANNEL 2 RUN= 2591 SERIES= 7
PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

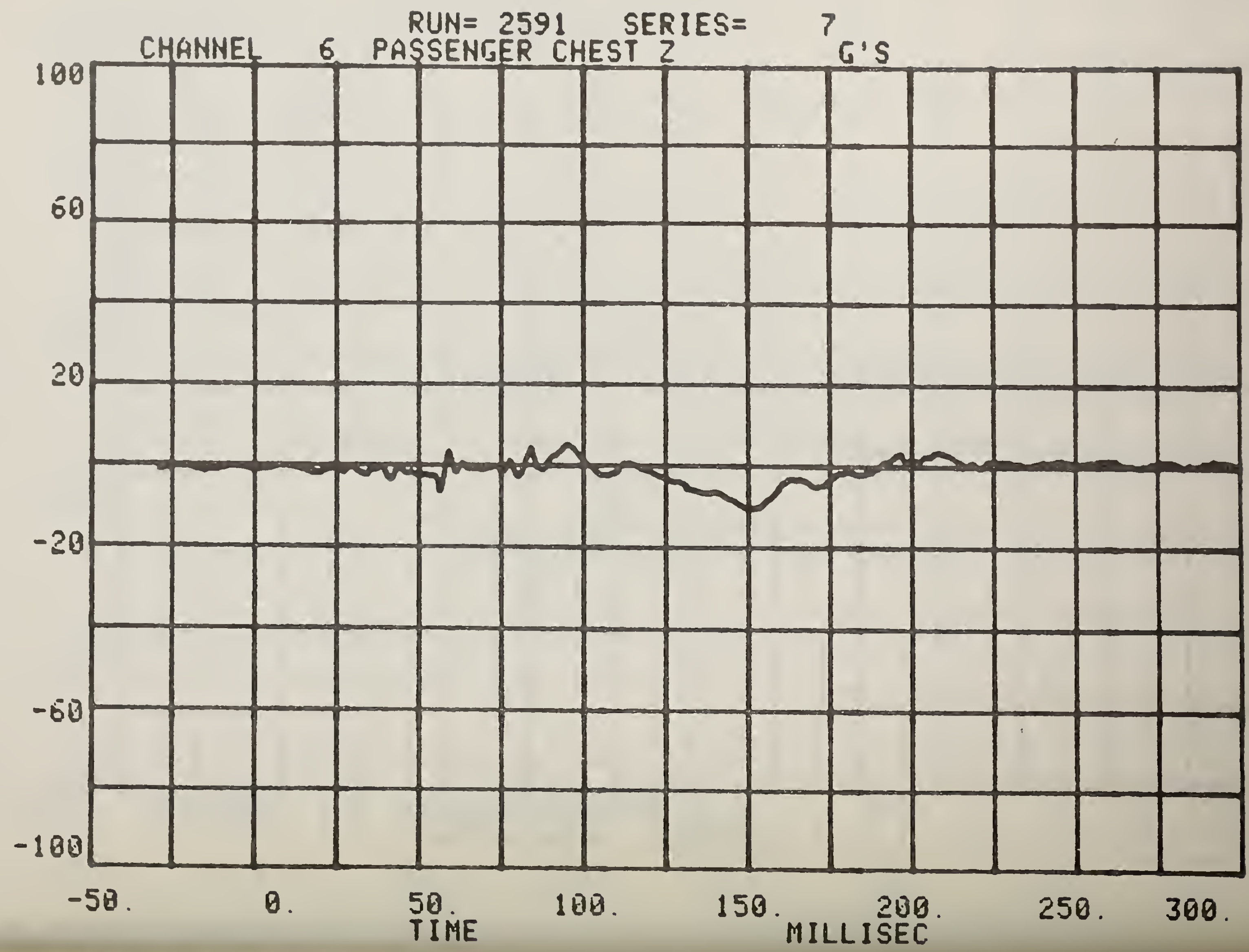

CHANNEL 3 RUN= 2591 SERIES= 7
PASSENGER HEAD Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

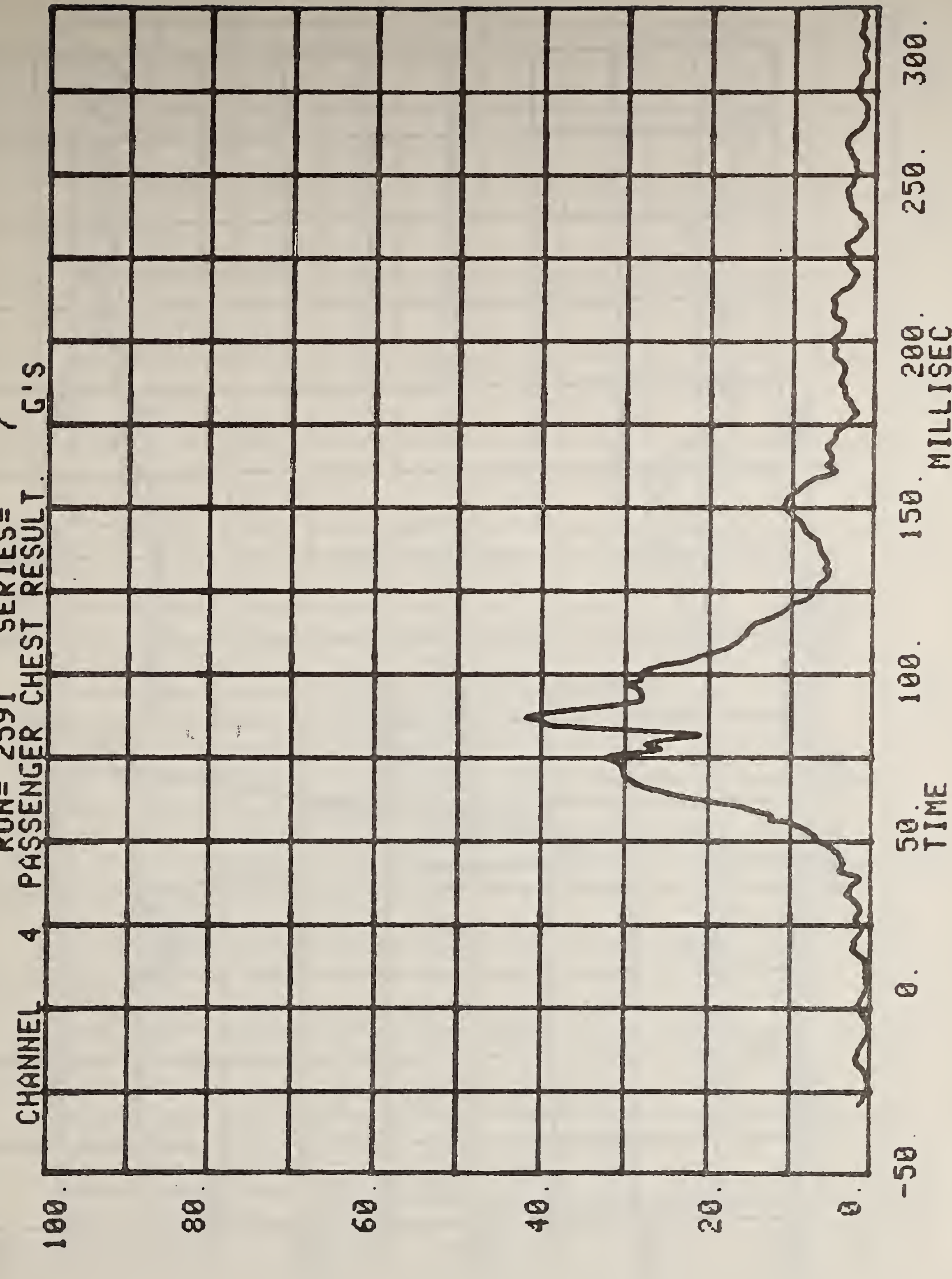


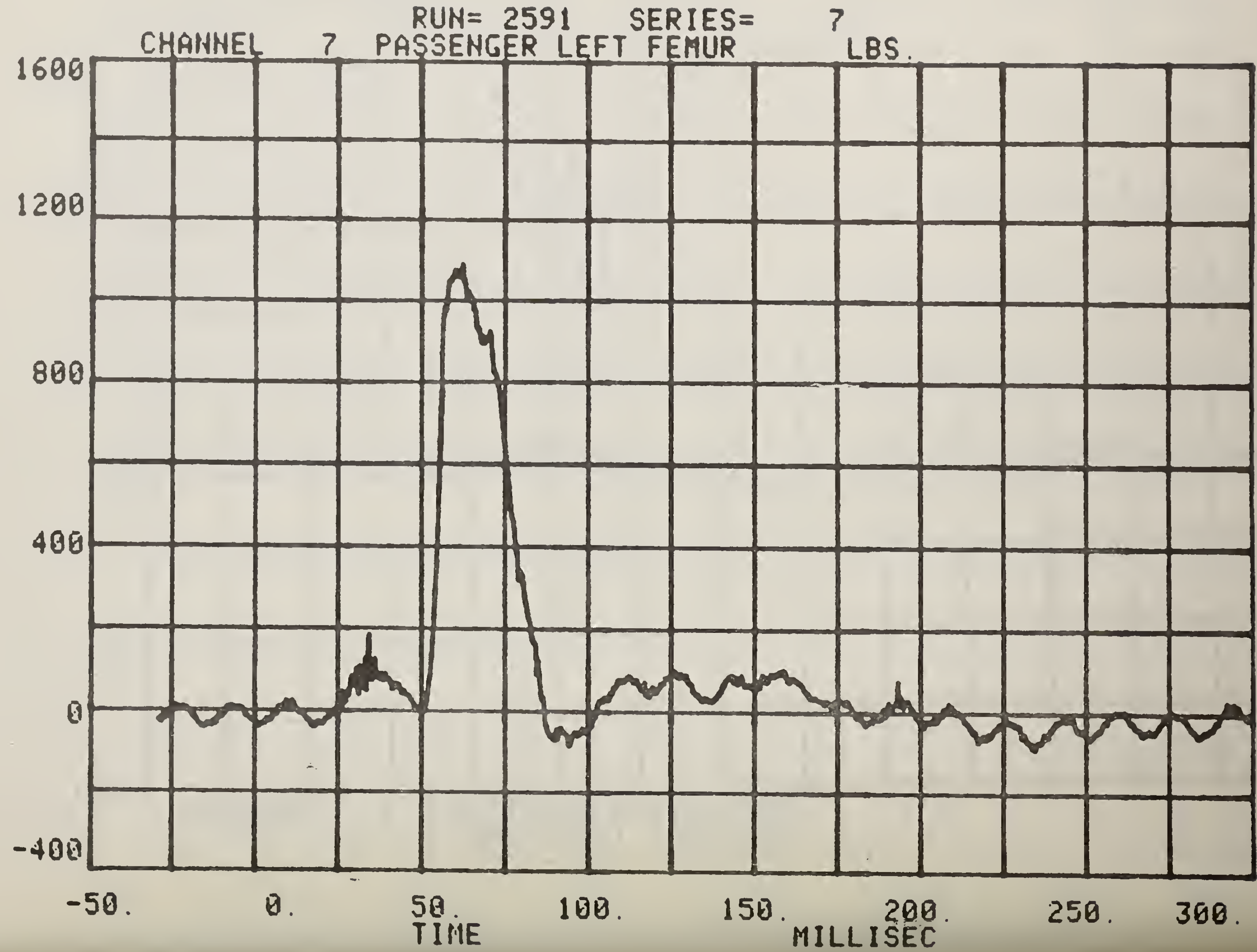
CHANNEL 3 RUN= 2591 SERIES= 7
PASSENGER HEAD RESULT. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

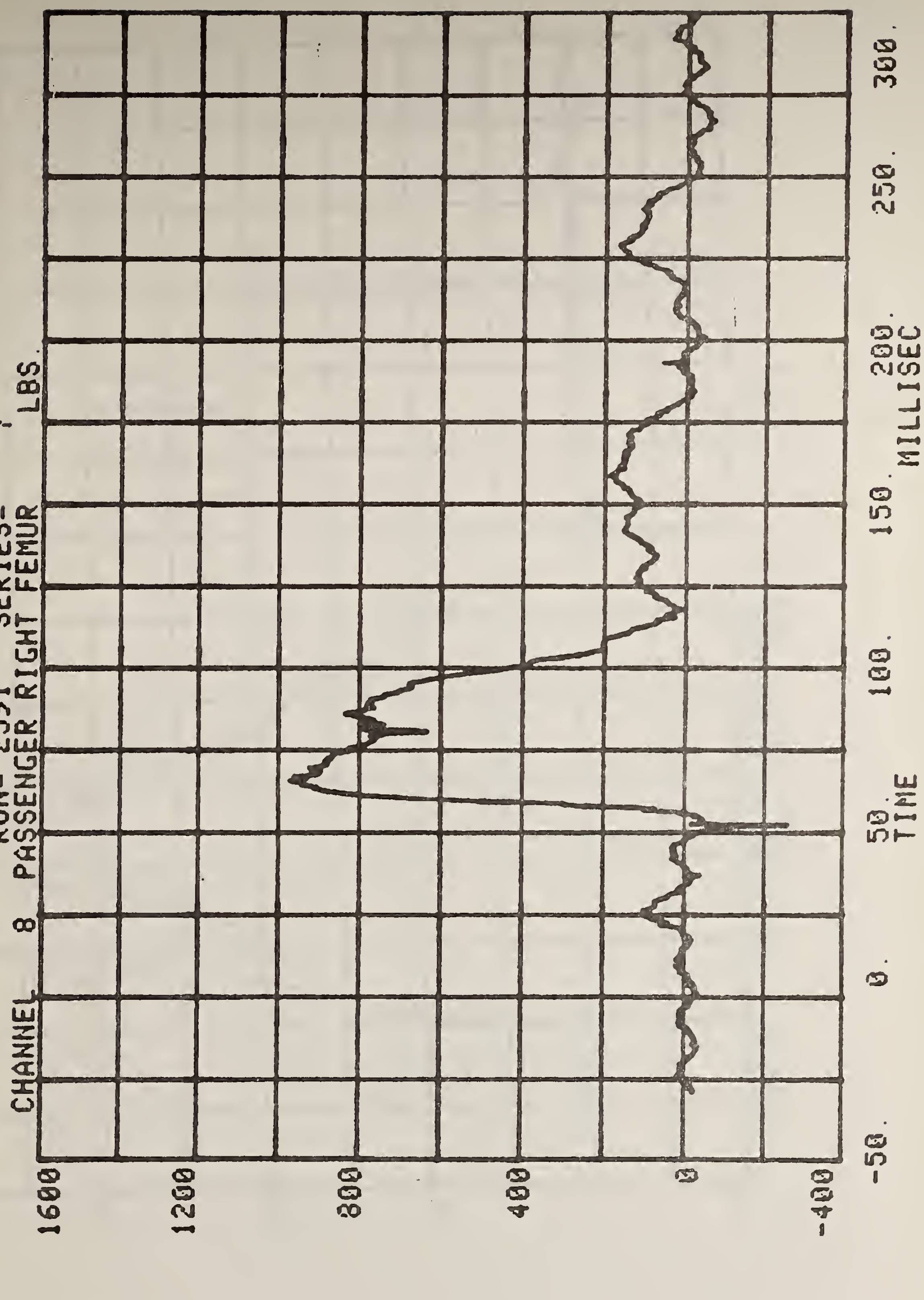

RUN= 2591 SERIES= 7
CHANNEL 4 PASSENGER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

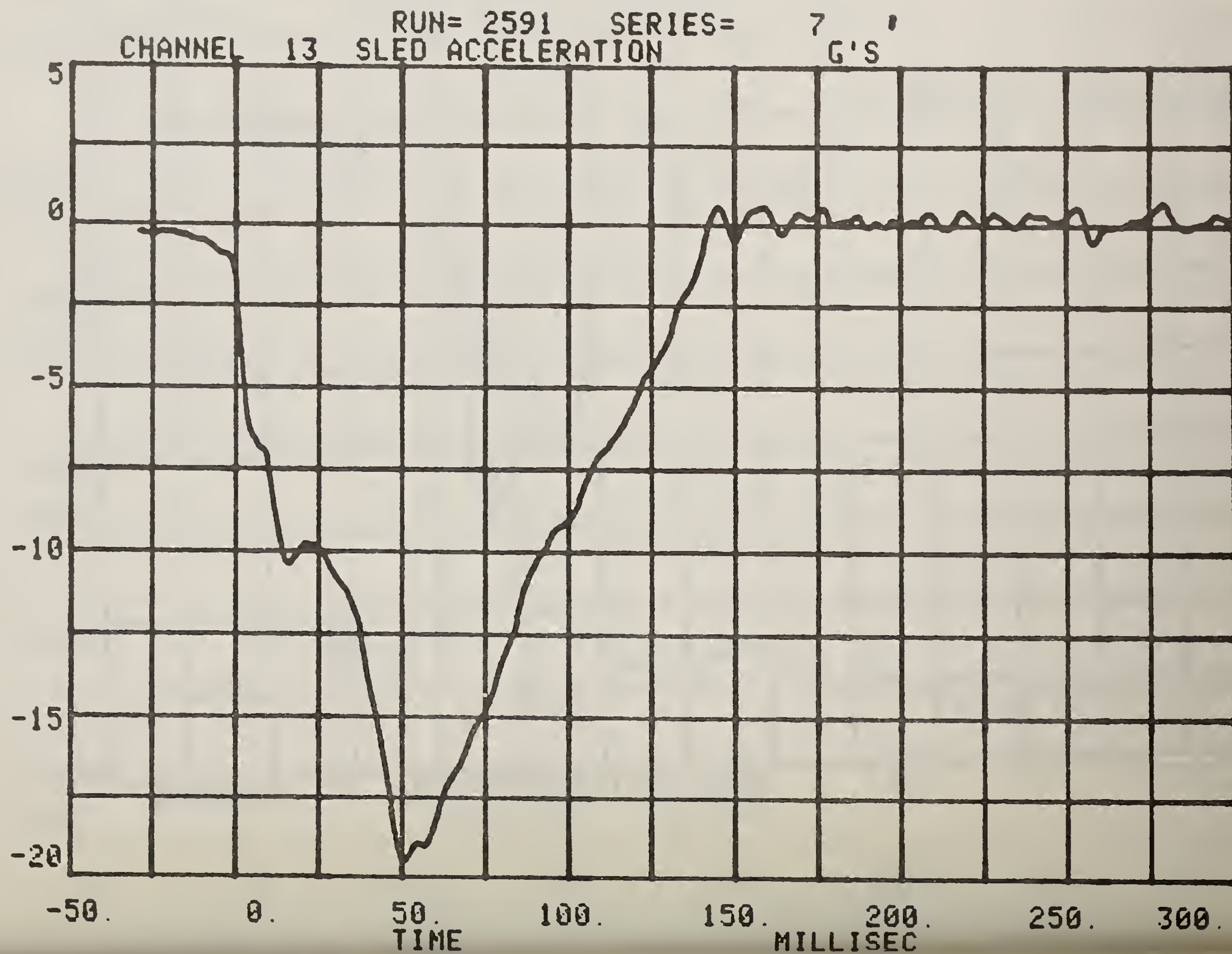

RUN= 2591 SERIES= 7
CHANNEL 5 PASSENGER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2591 SERIES= 7
CHANNEL 6 PASSENGER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 4 RUN= 2591 SERIES= 7
PASSENGER CHEST RESULT. G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2591 SERIES= 7
CHANNEL 7 PASSENGER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2591 SERIES= 7
CHANNEL 8 PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2591 SERIES= 7
CHANNEL 13 SLED ACCELERATION G'S
5
0
-5
-10
-15
-20
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

APPENDIX C

FRONTAL IMPACT SLED TEST DATA RECORDS
SLED RUN NOS. 2622-2629

Measurement	Filter Channel Class
Head Accelerations	1000
Chest Accelerations	180
Femur Loads	600
Sled Acceleration	60

Sequence of Data Records

Driver

Head - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Femur Load - Left, Right

Passenger

HIC - HIC, X, Y, Z, Resultant Accelerations

Chest - X, Y, Z, Resultant Accelerations

Femur Load - Left, Right

Sled Acceleration

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2622

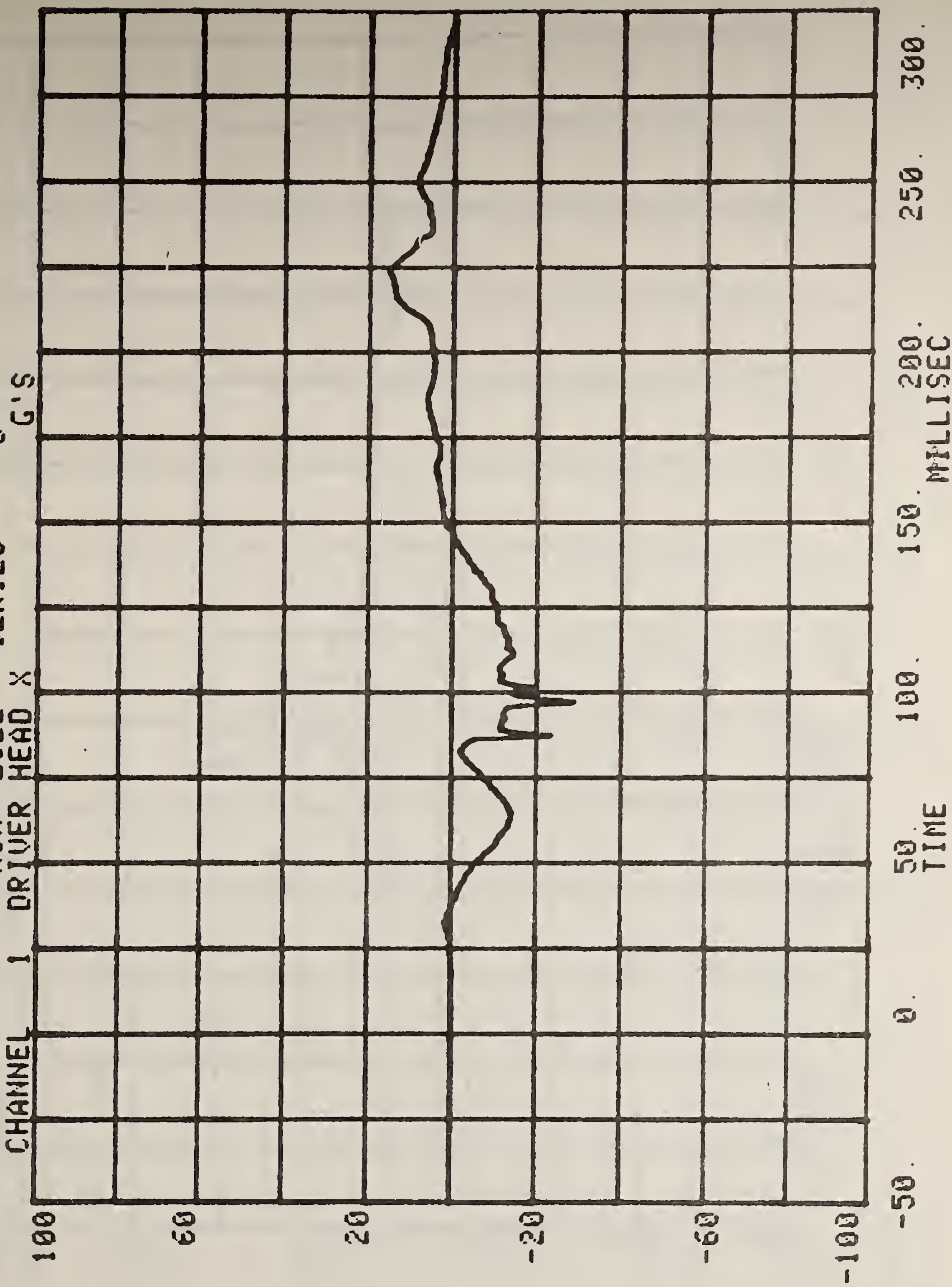
DRIVER HEAD RESULTANT

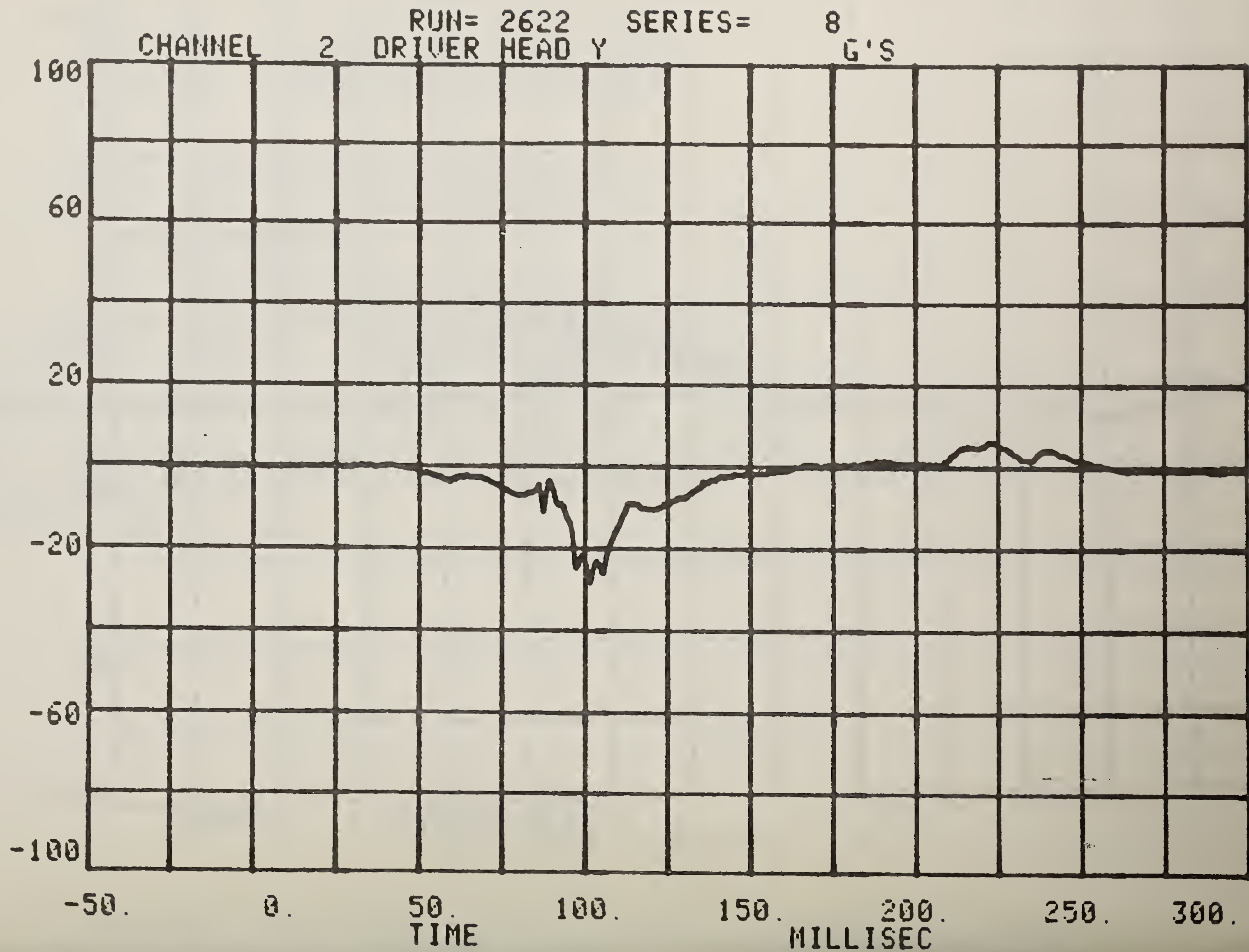
HIC= 363.0   FROM T1= .05850   TO T2= .10980

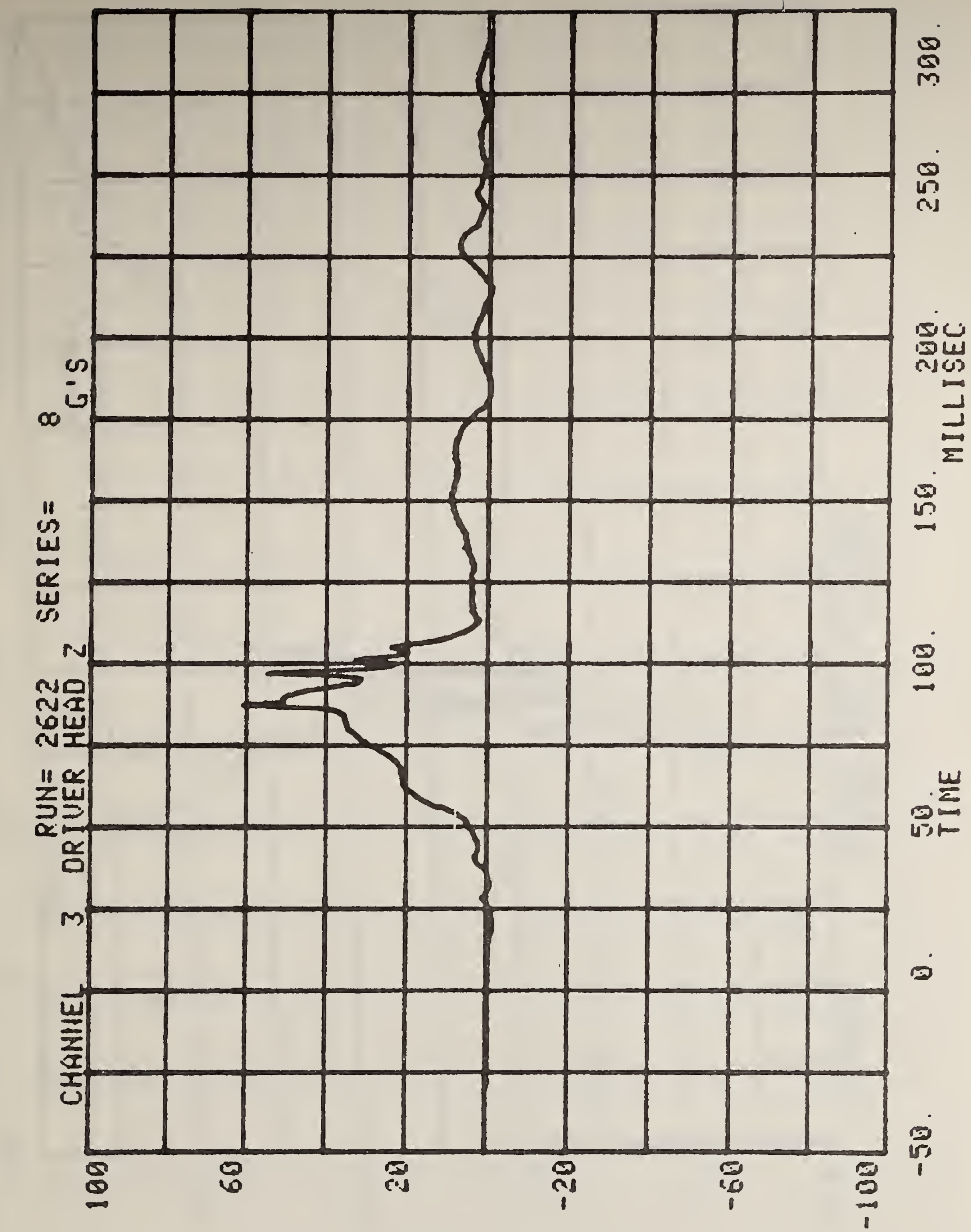
AVERAGE ACCELERATION BETWEEN T1 AND T2= 34.7G'S

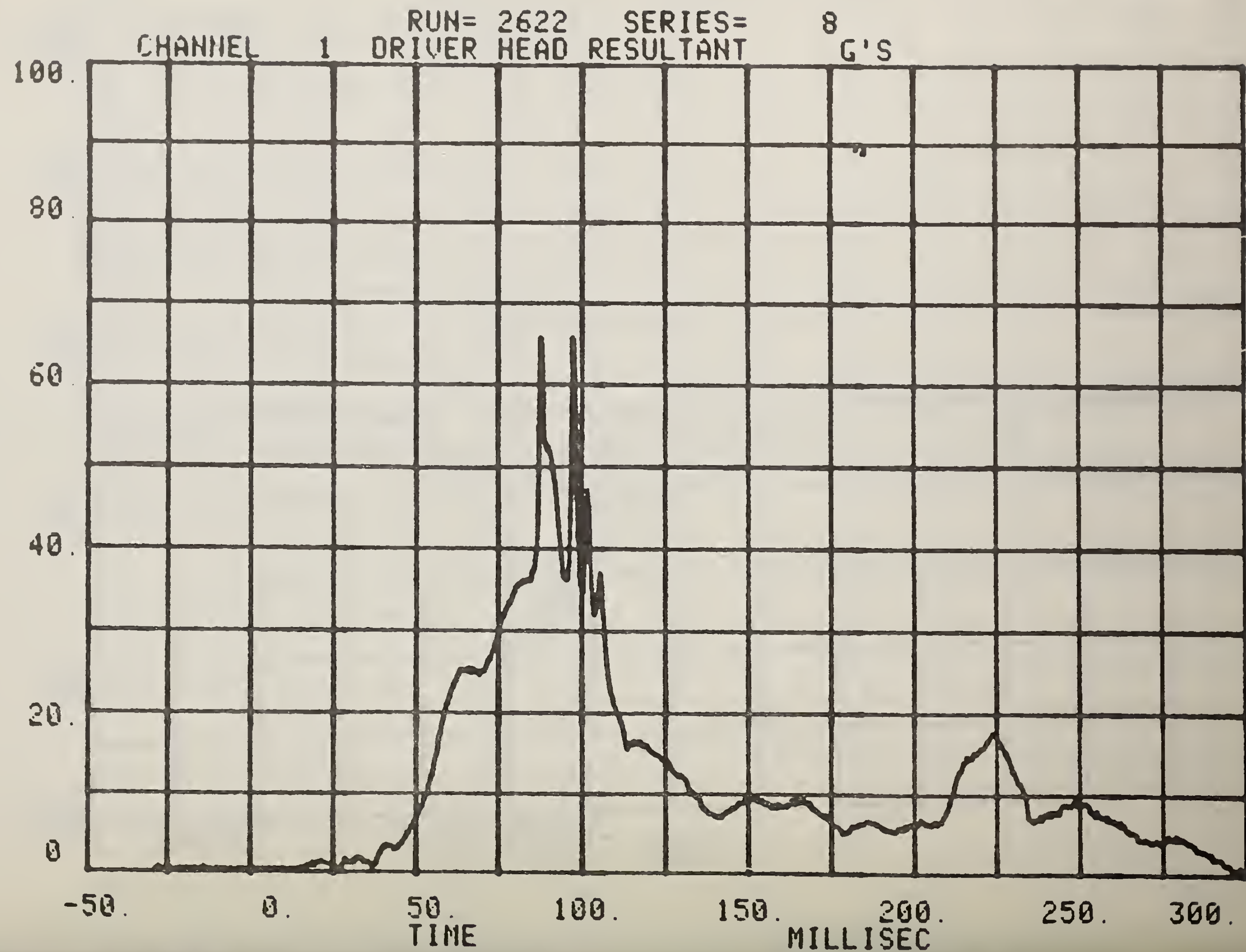
EVENT TIME= 300.0 MSEC

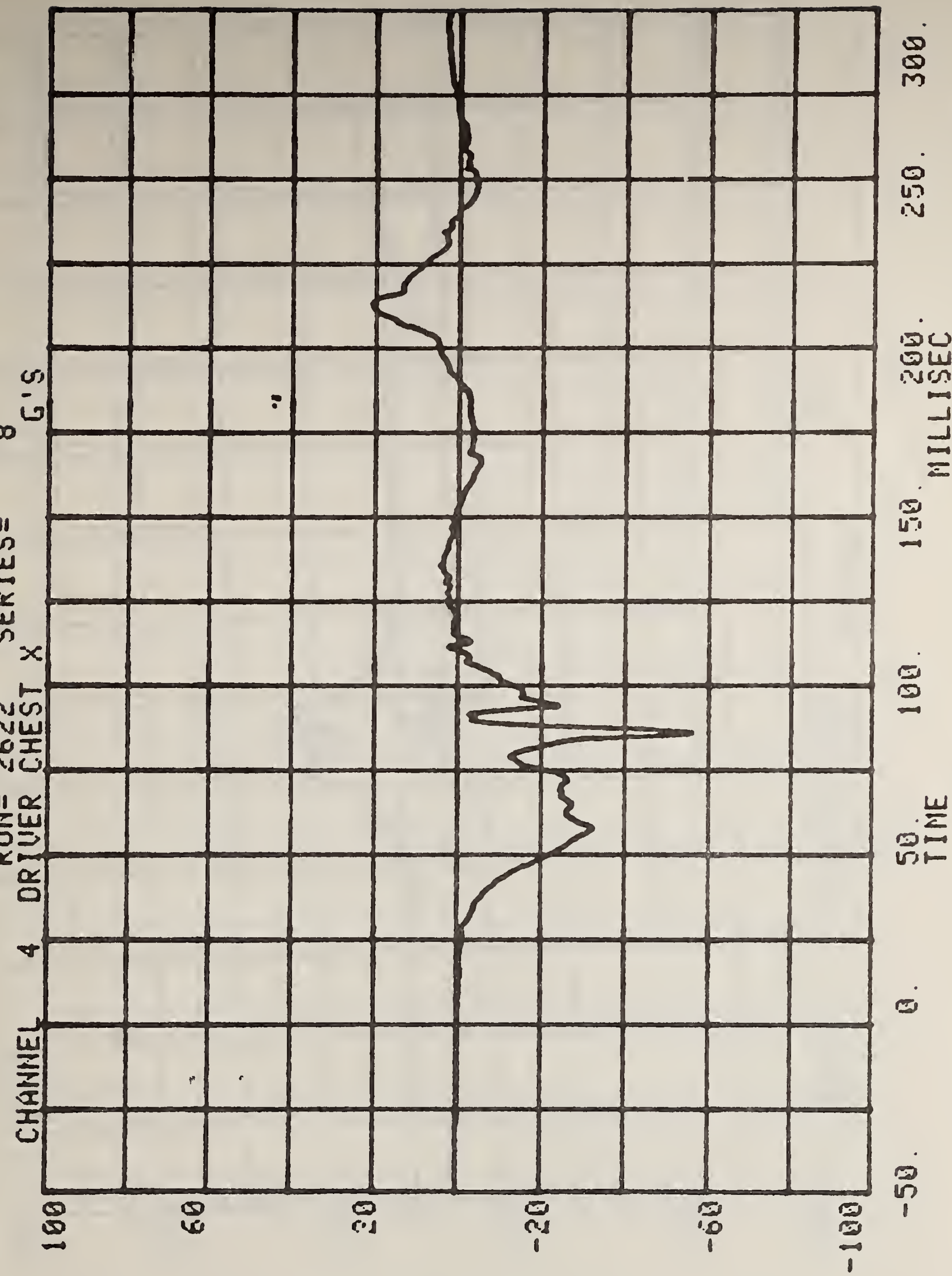
SEVERITY INDEX= 490.4

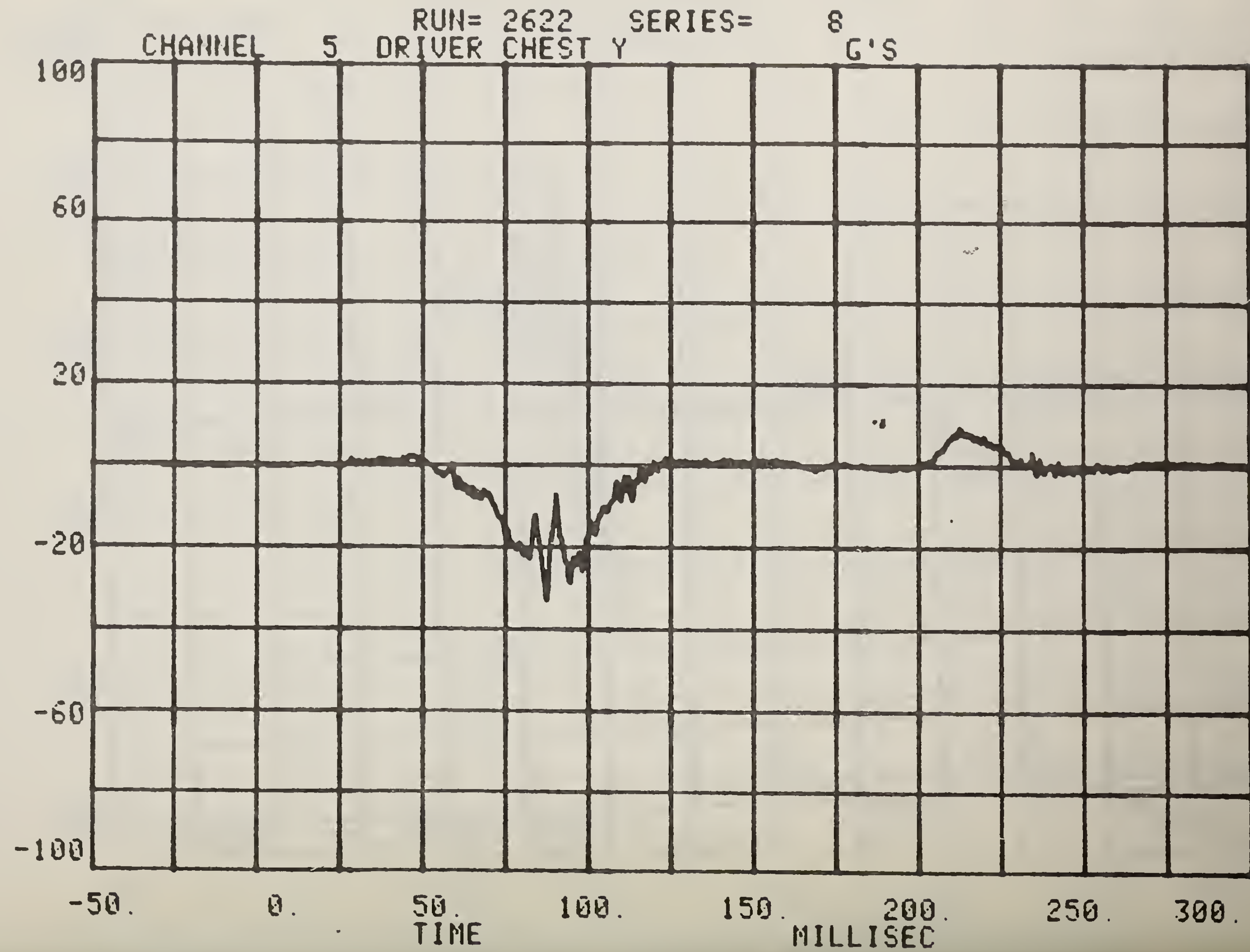

CHANNEL 1 RUN= 2622 SERIES= 8
DRIVER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

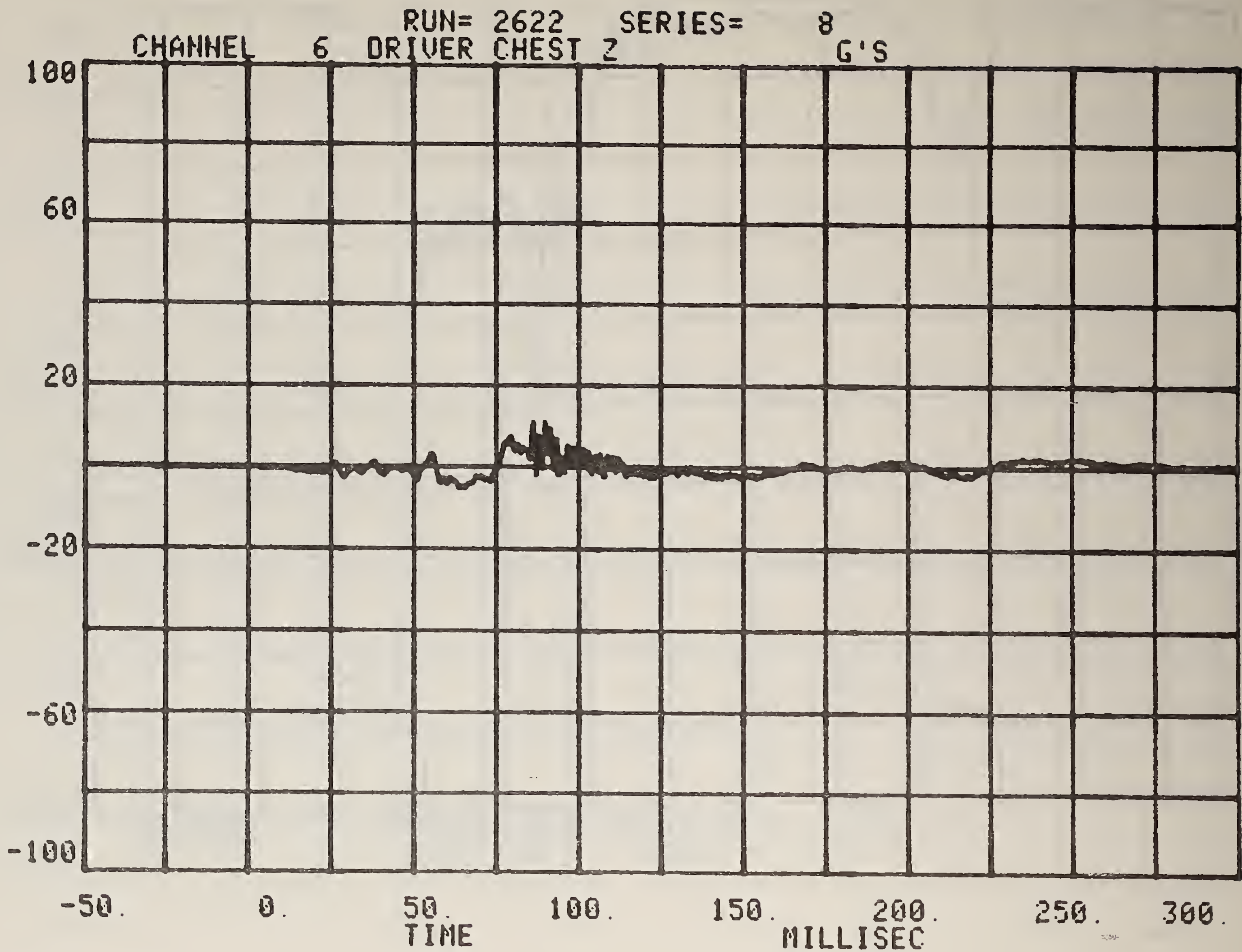

RUN= 2622 SERIES= 8
CHANNEL 2 DRIVER HEAD Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

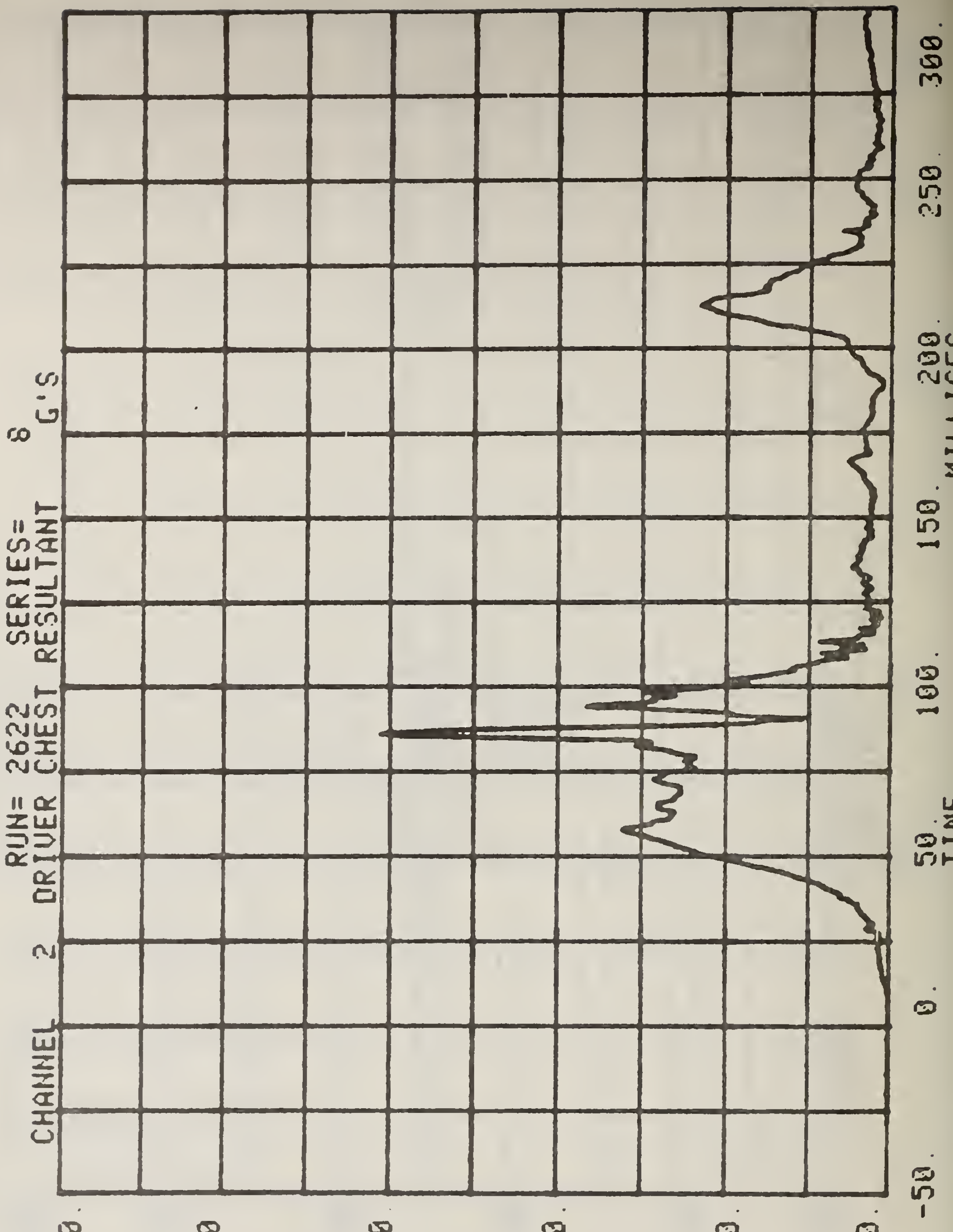

CHANNEL 3 RUN= 2622 SERIES= 8
DRIVER HEAD Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

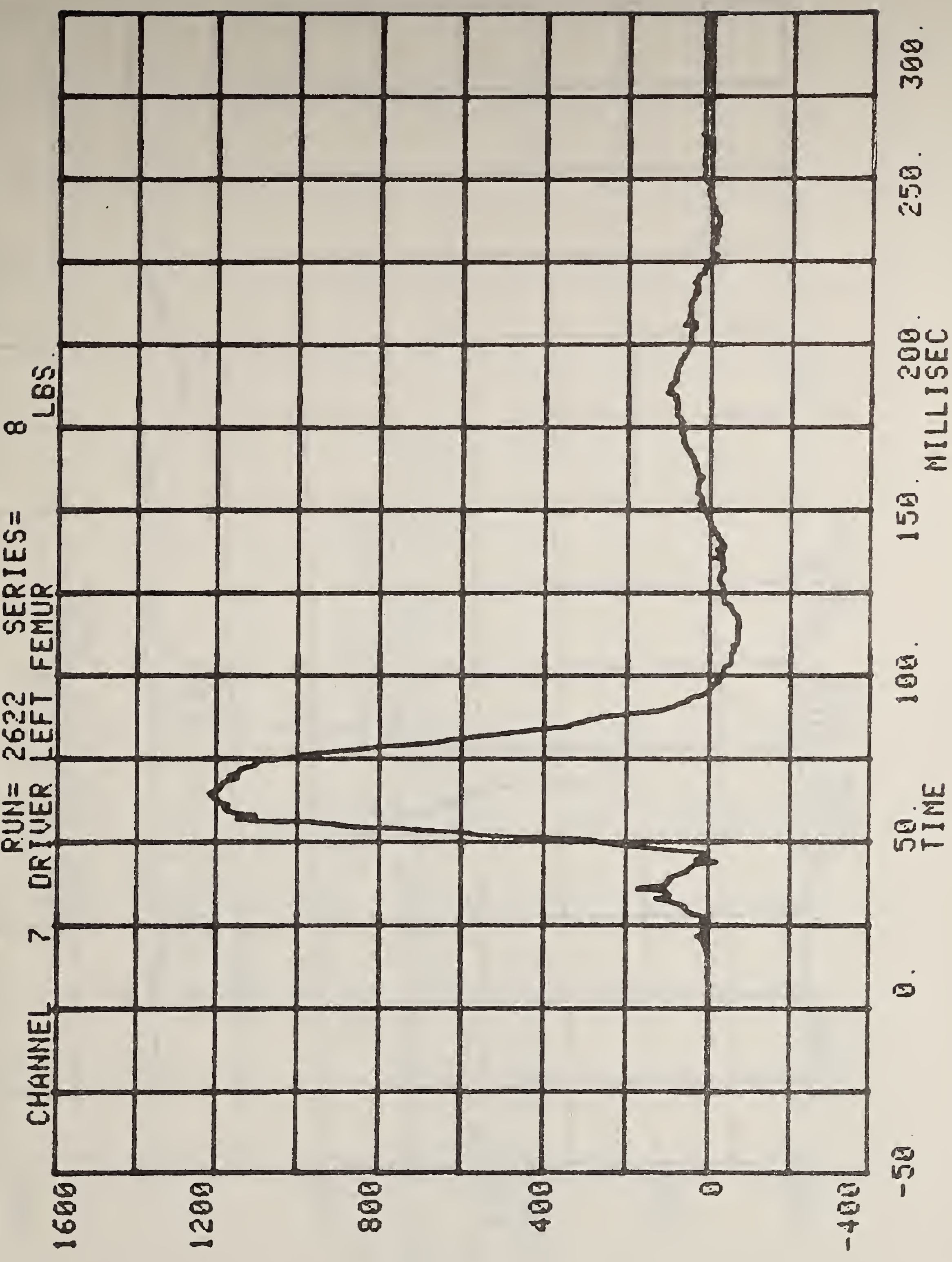

RUN= 2622 SERIES= 8
CHANNEL 1 DRIVER HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

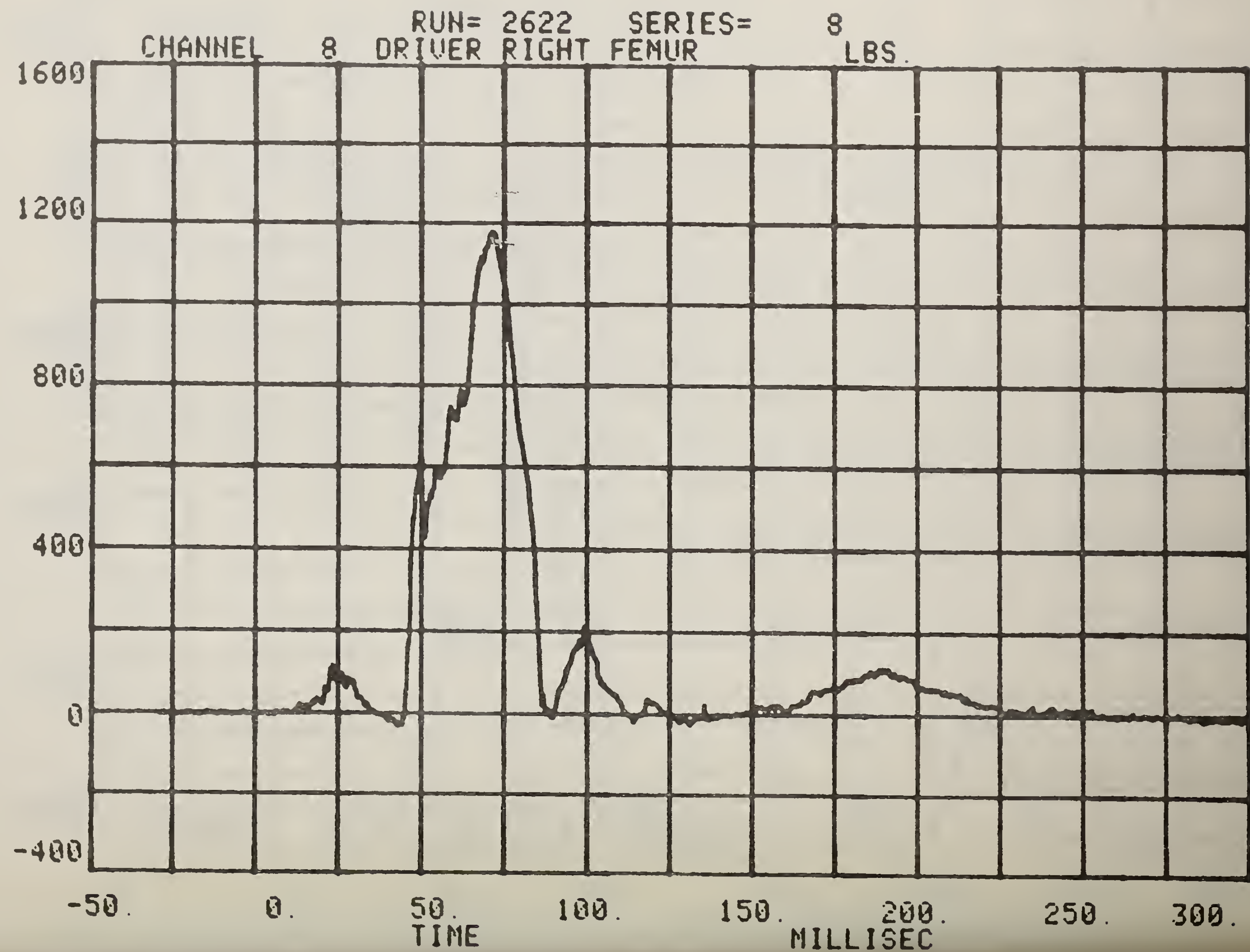

CHANNEL 4 RUN= 2622 SERIES= 8
DRIVER CHEST X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2622 SERIES= 8
CHANNEL 5 DRIVER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2622 SERIES= 8
CHANNEL 6 DRIVER CHEST Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 2 RUN= 2622 SERIES= 8
DRIVER CHEST RESULTANT G'S
100.
80
60
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 7 RUN= 2622 SERIES= 8
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



RUN= 2622 SERIES= 8
CHANNEL 8 DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2622

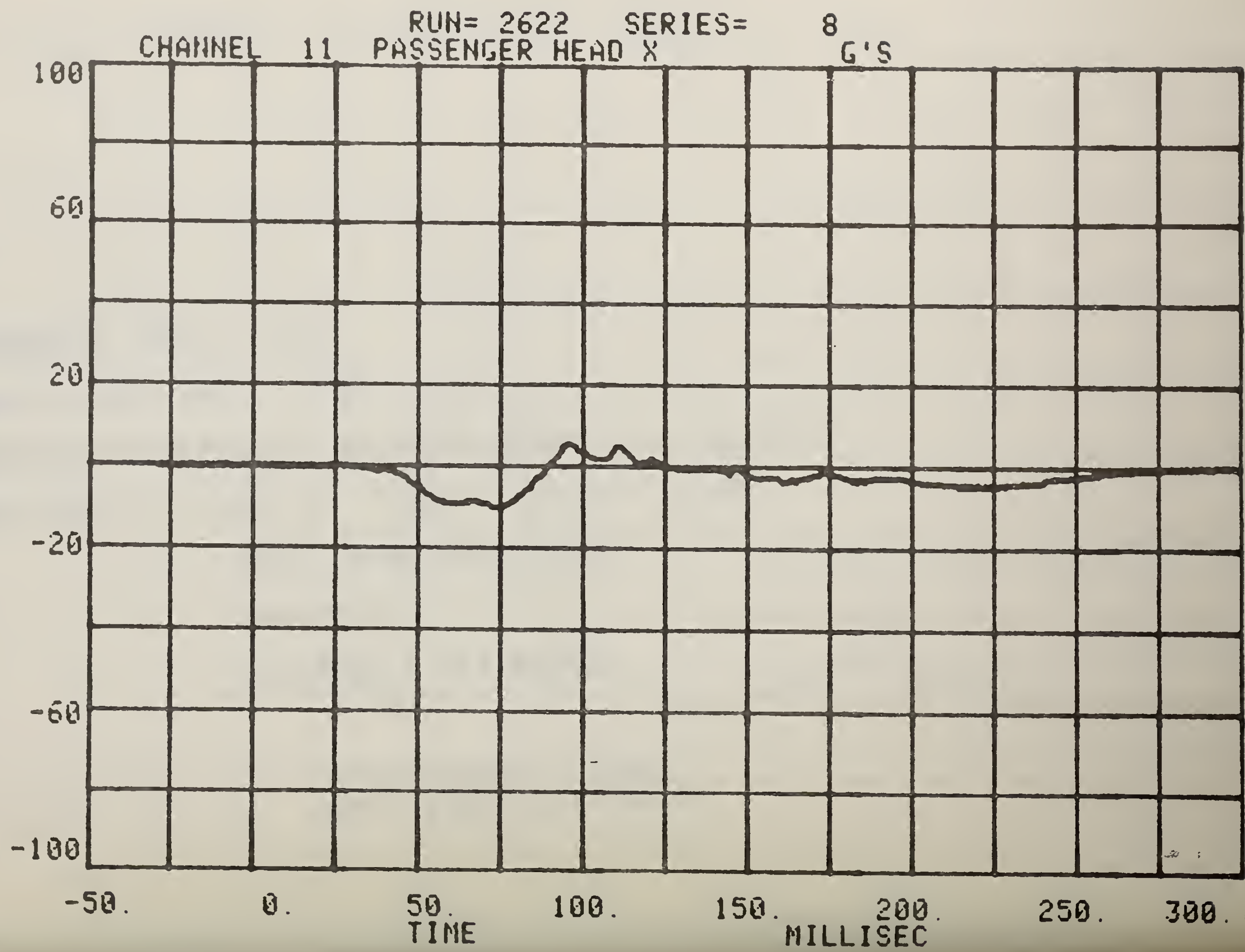
PASS. HEAD RESULTANT

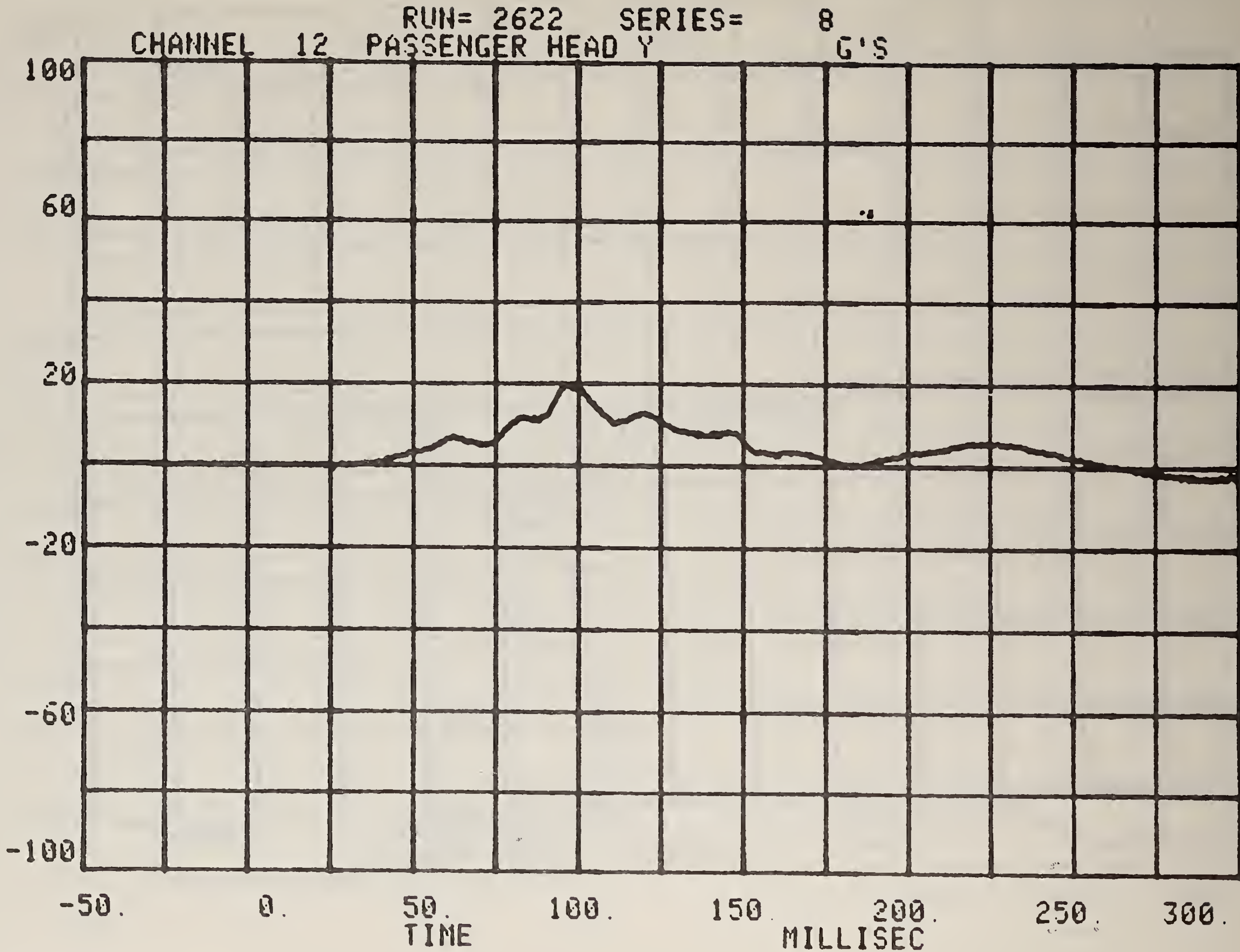
HIC= 167.0   FROM T1= .05790   TO T2= .11100

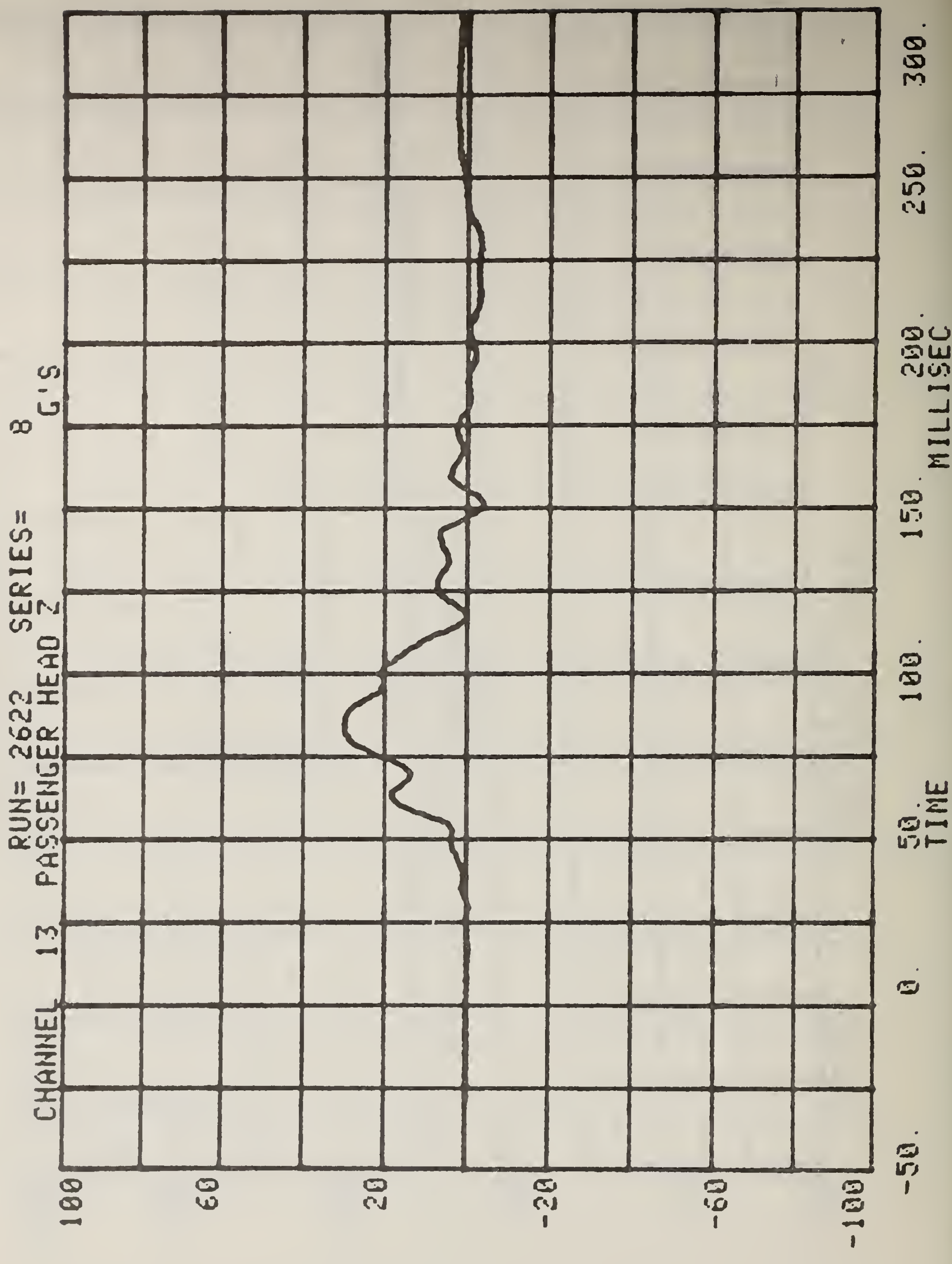
AVERAGE ACCELERATION BETWEEN T1 AND T2= 25.1G'S

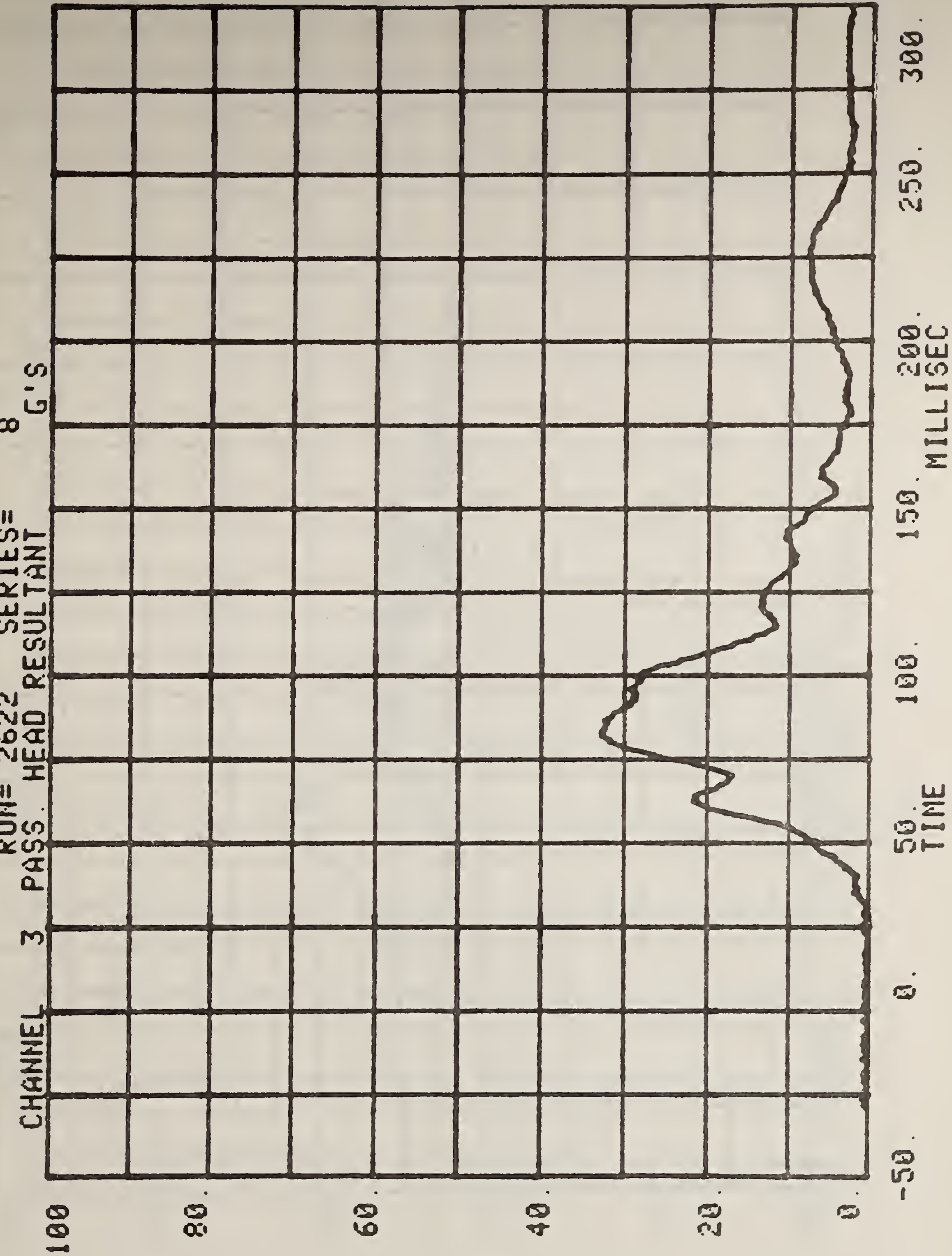
EVENT TIME= 300.0 MSEC

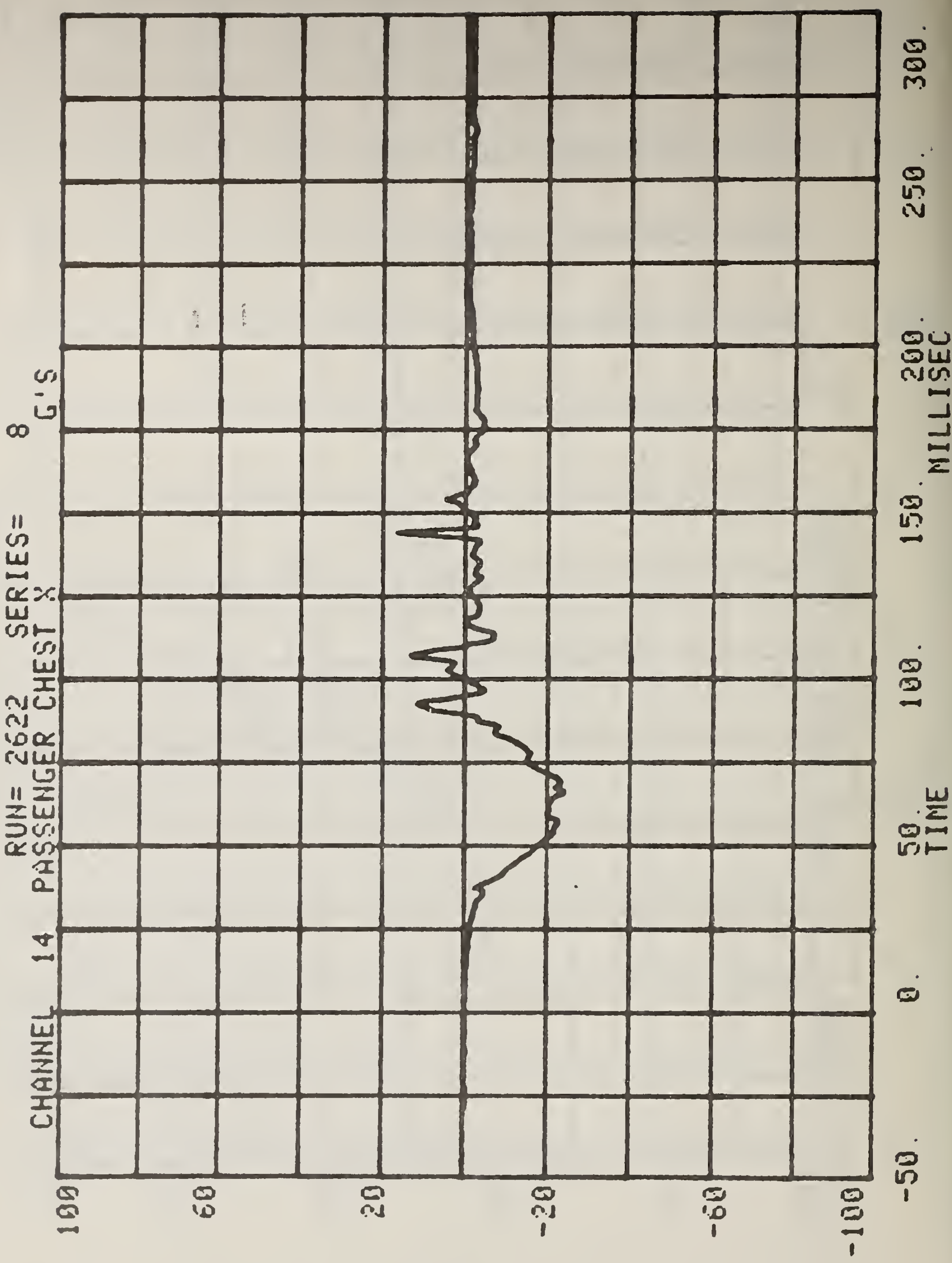
SEVERITY INDEX= 210.0

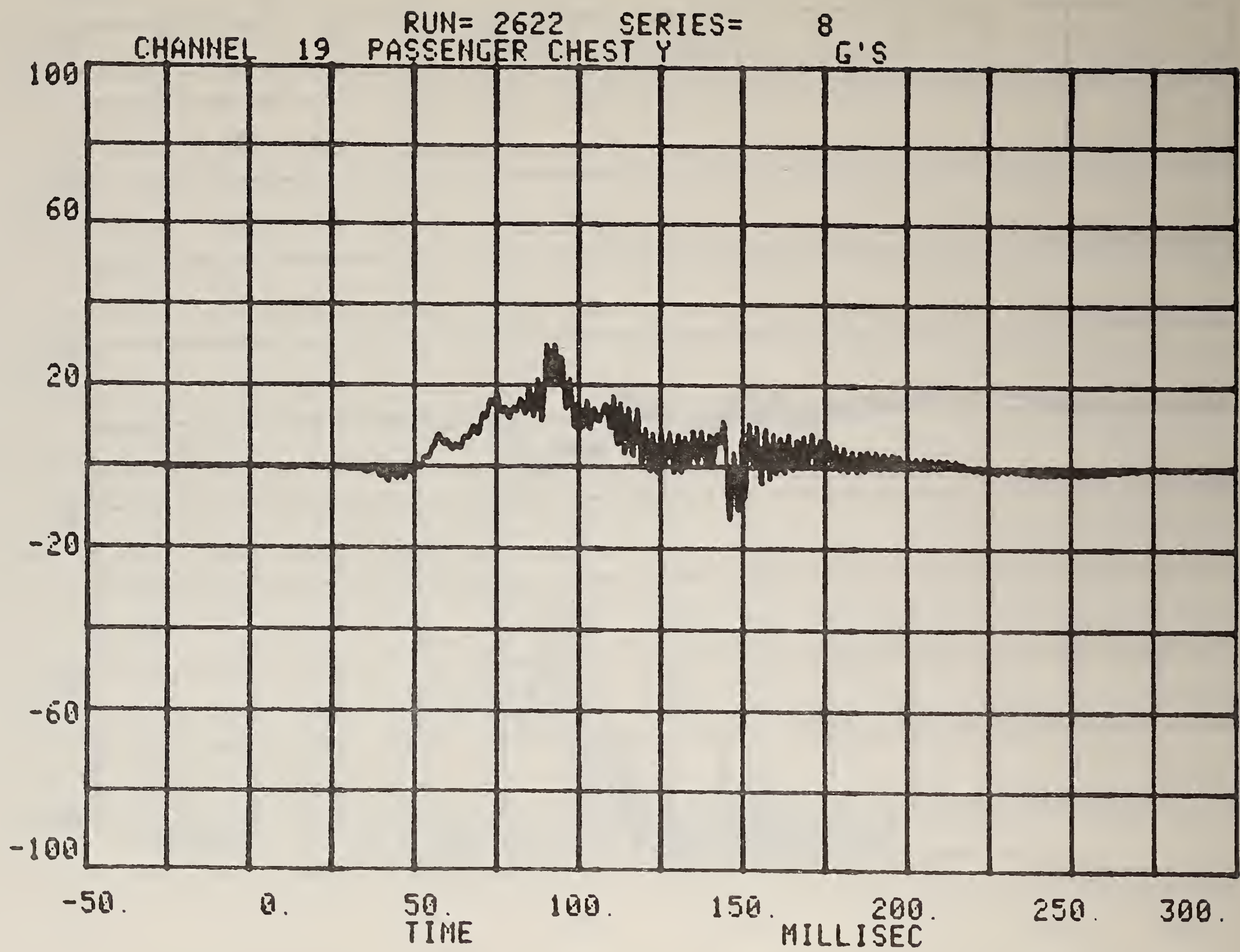

RUN= 2622 SERIES= 8
CHANNEL 11 PASSENGER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

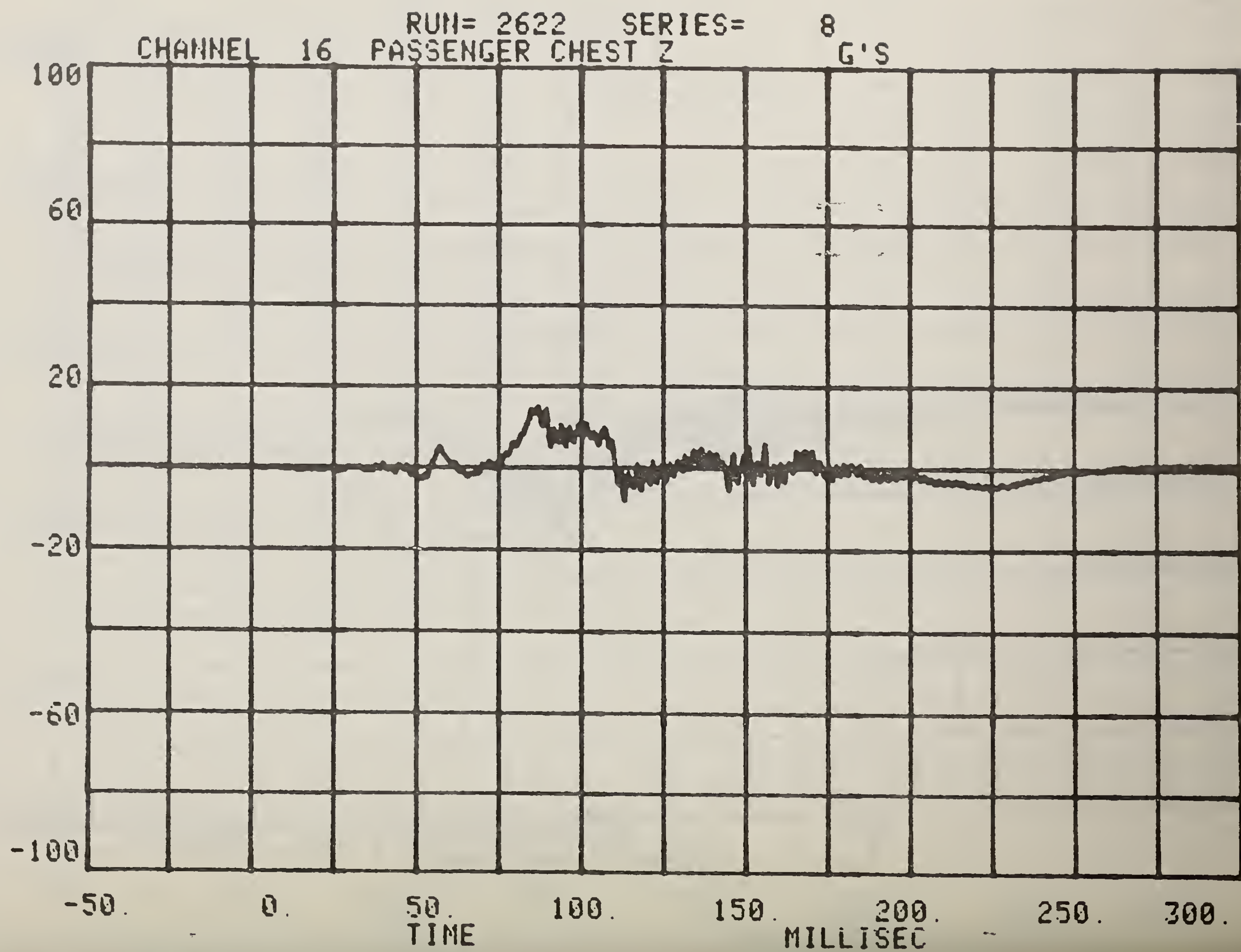

RUN= 2622 SERIES= 8
CHANNEL 12 PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150
200.
250
300.
TIME
MILLISEC

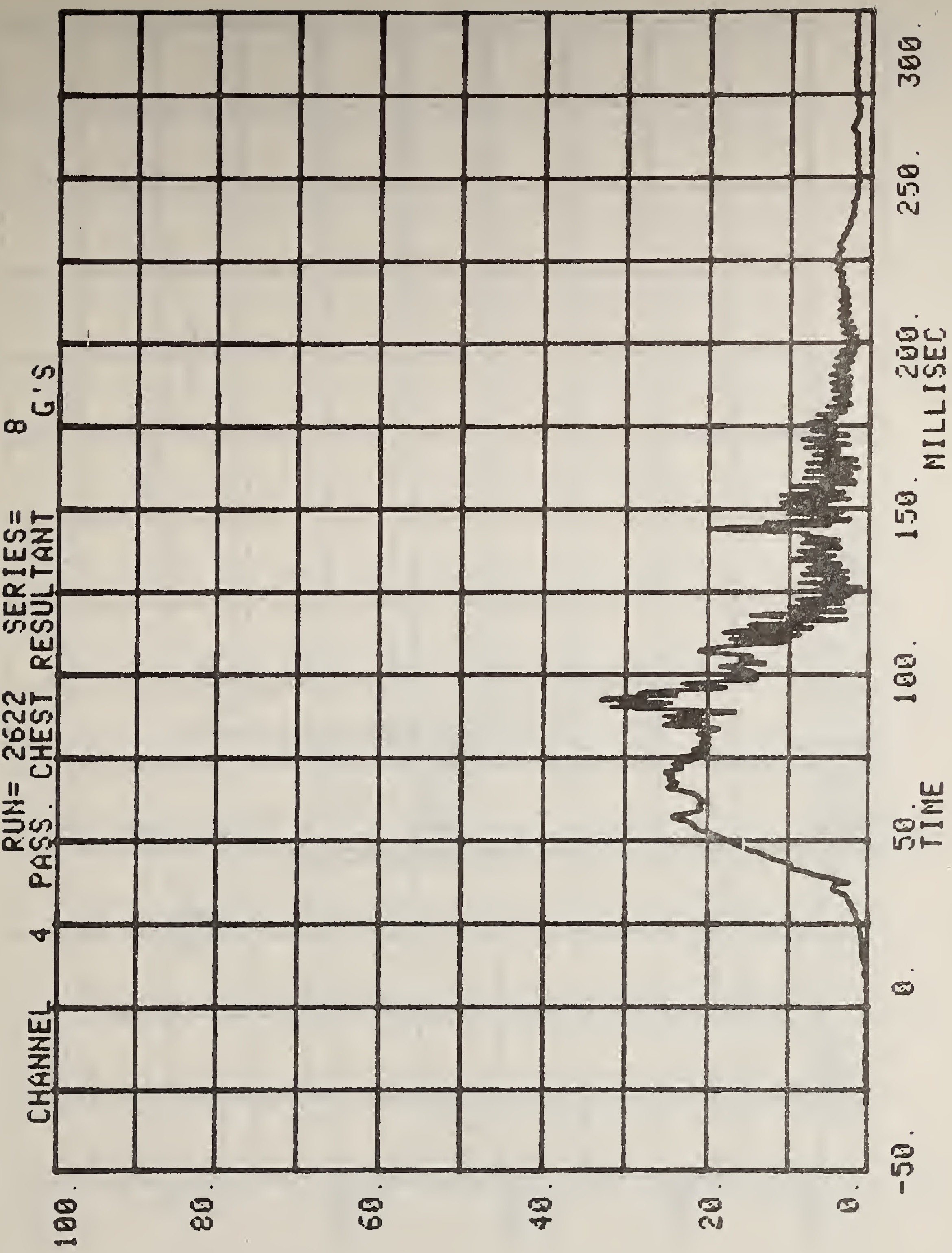

CHANNEL 13
RUN= 2622 SERIES= 8
PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

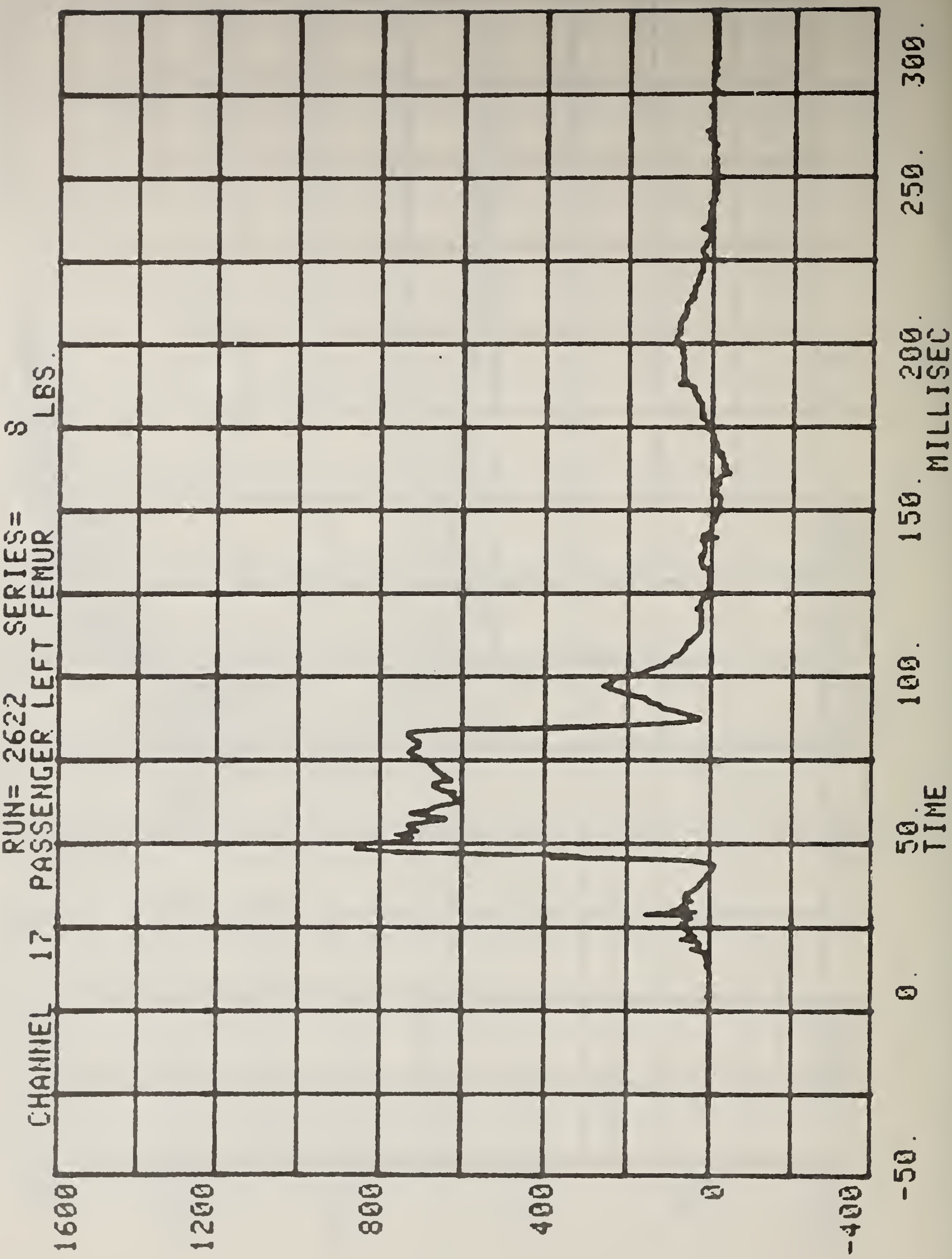

CHANNEL 3 RUN= 2622 SERIES= 8
PASS. HEAD RESULTANT G'S
100
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

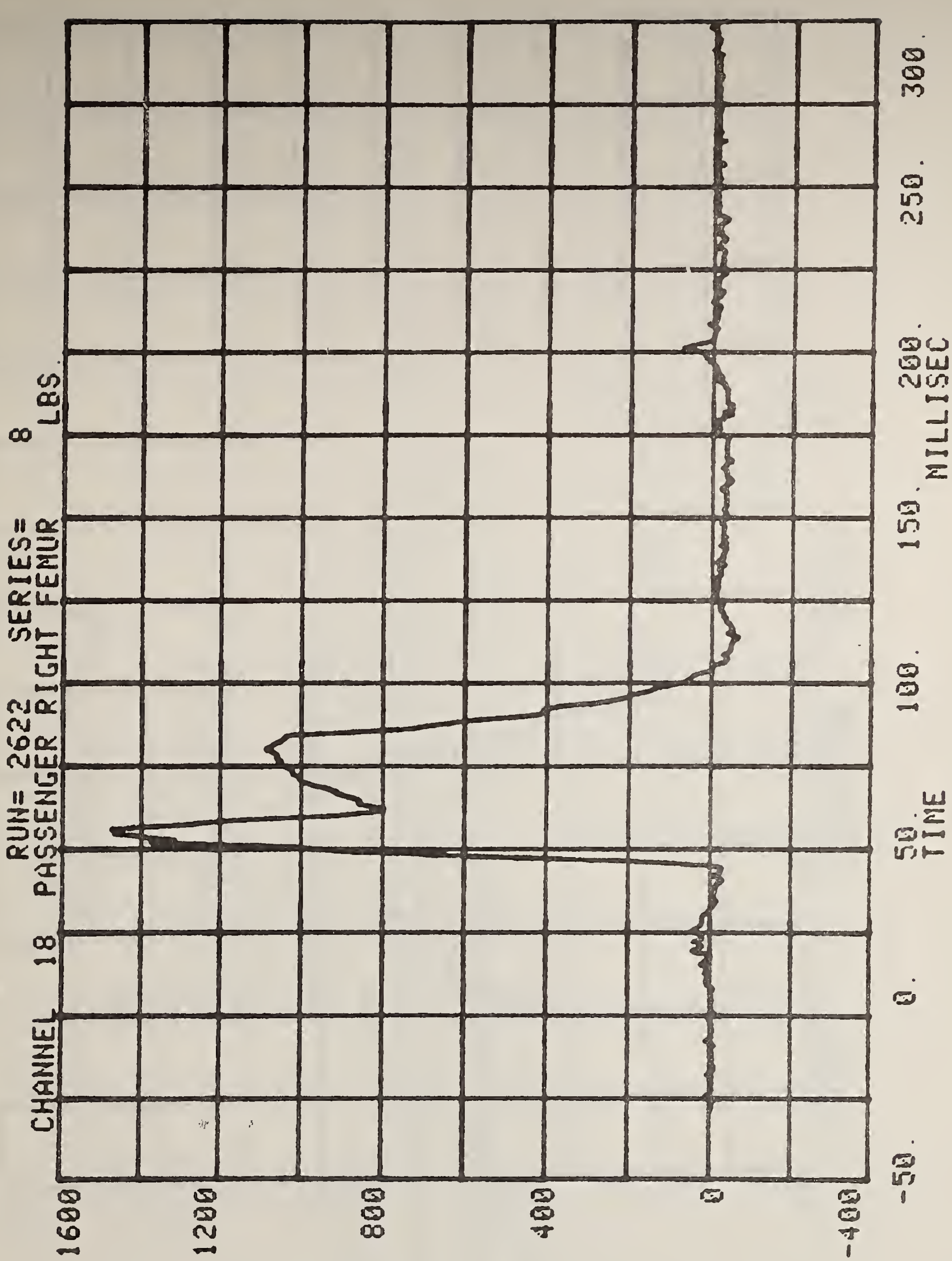

CHANNEL 14 RUN= 2622 SERIES= 8
PASSENGER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

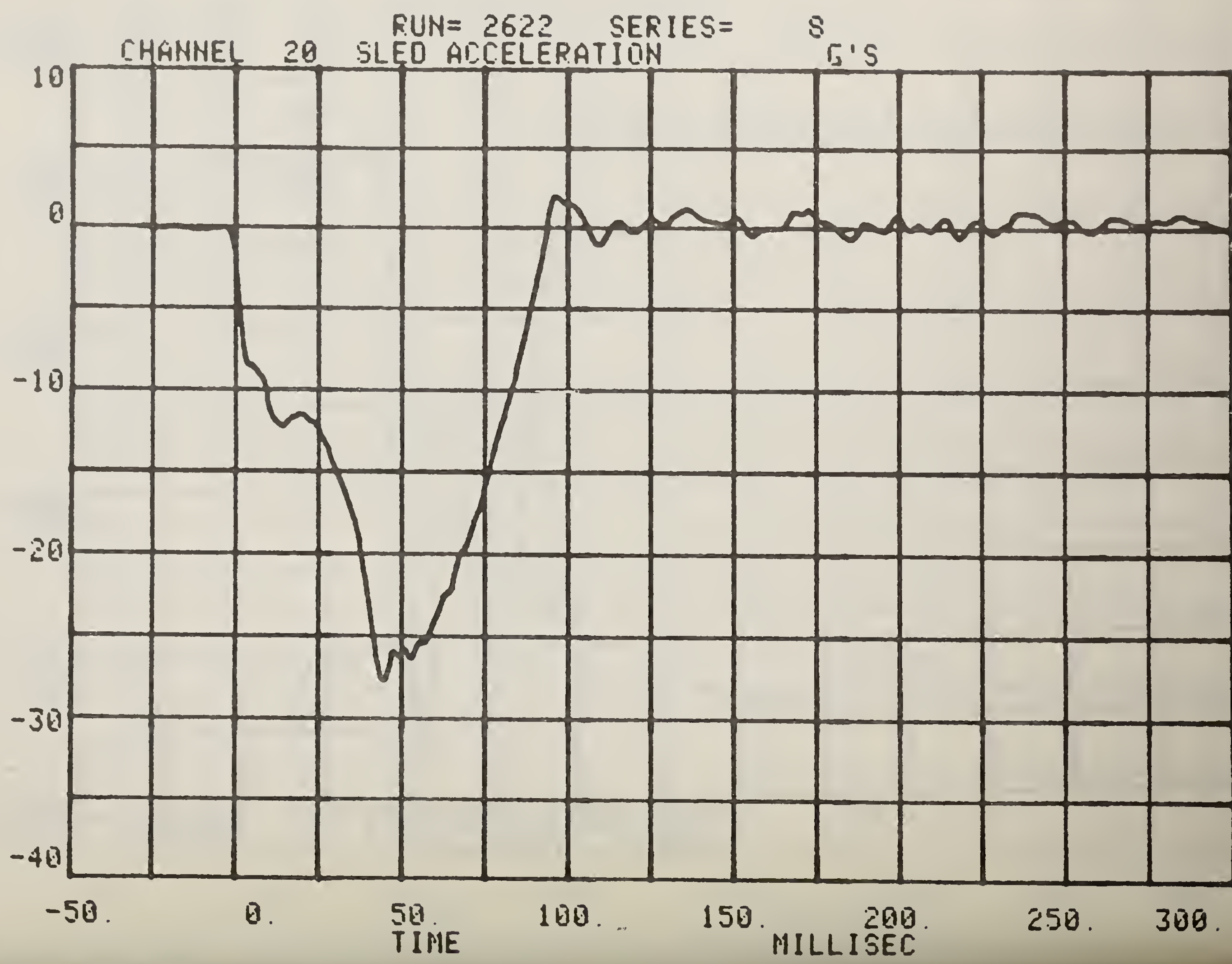

RUN= 2622 SERIES= 8
CHANNEL 19 PASSENGER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2622 SERIES= 8
CHANNEL 16 PASSENGER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 4 RUN= 2622 SERIES= 8
PASS. CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 17 RUN= 2622 SERIES= S
PASSENGER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 18 RUN= 2622 SERIES= 8
PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2622 SERIES= 8
CHANNEL 20 SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2623

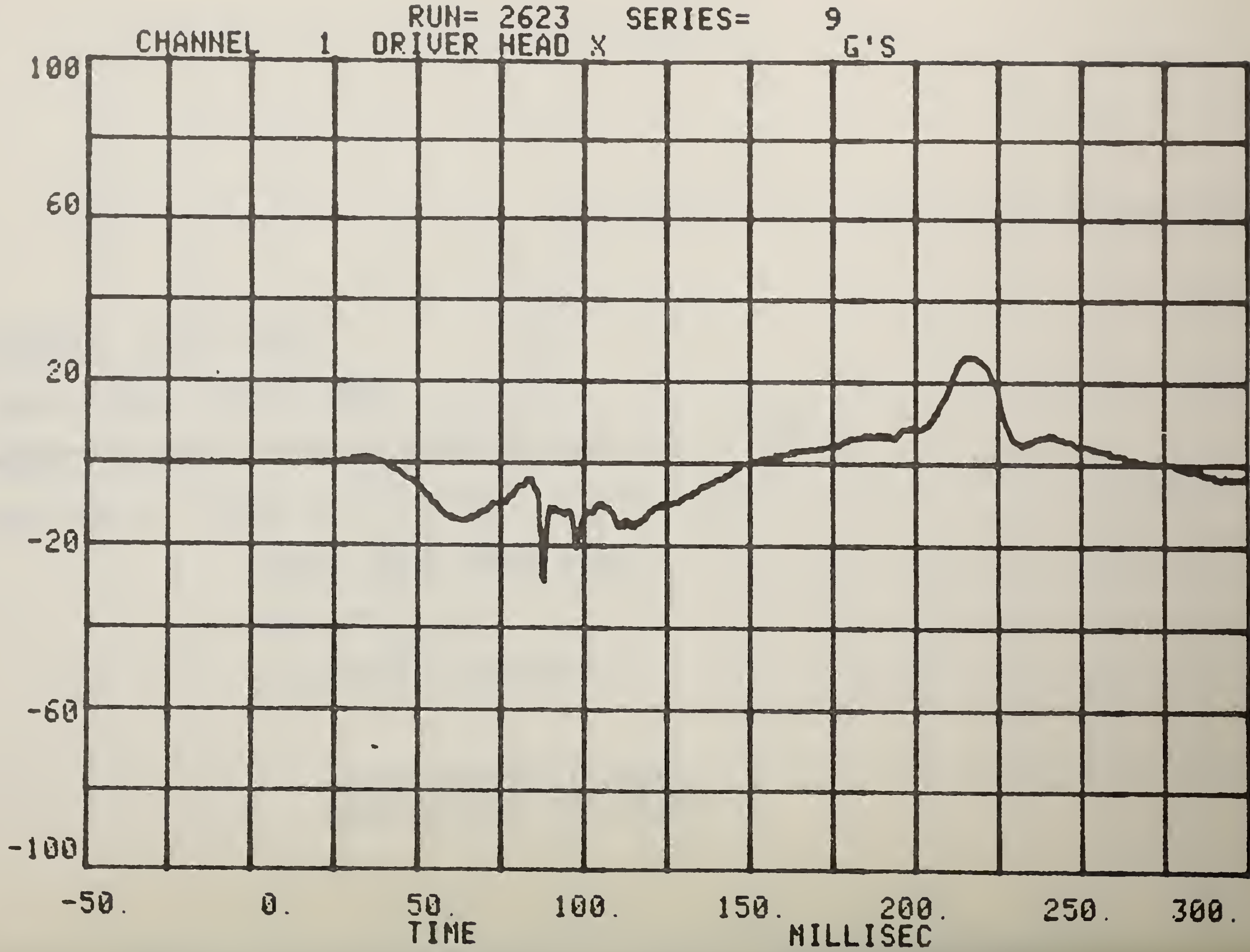
DRIVER HEAD RESULTANT

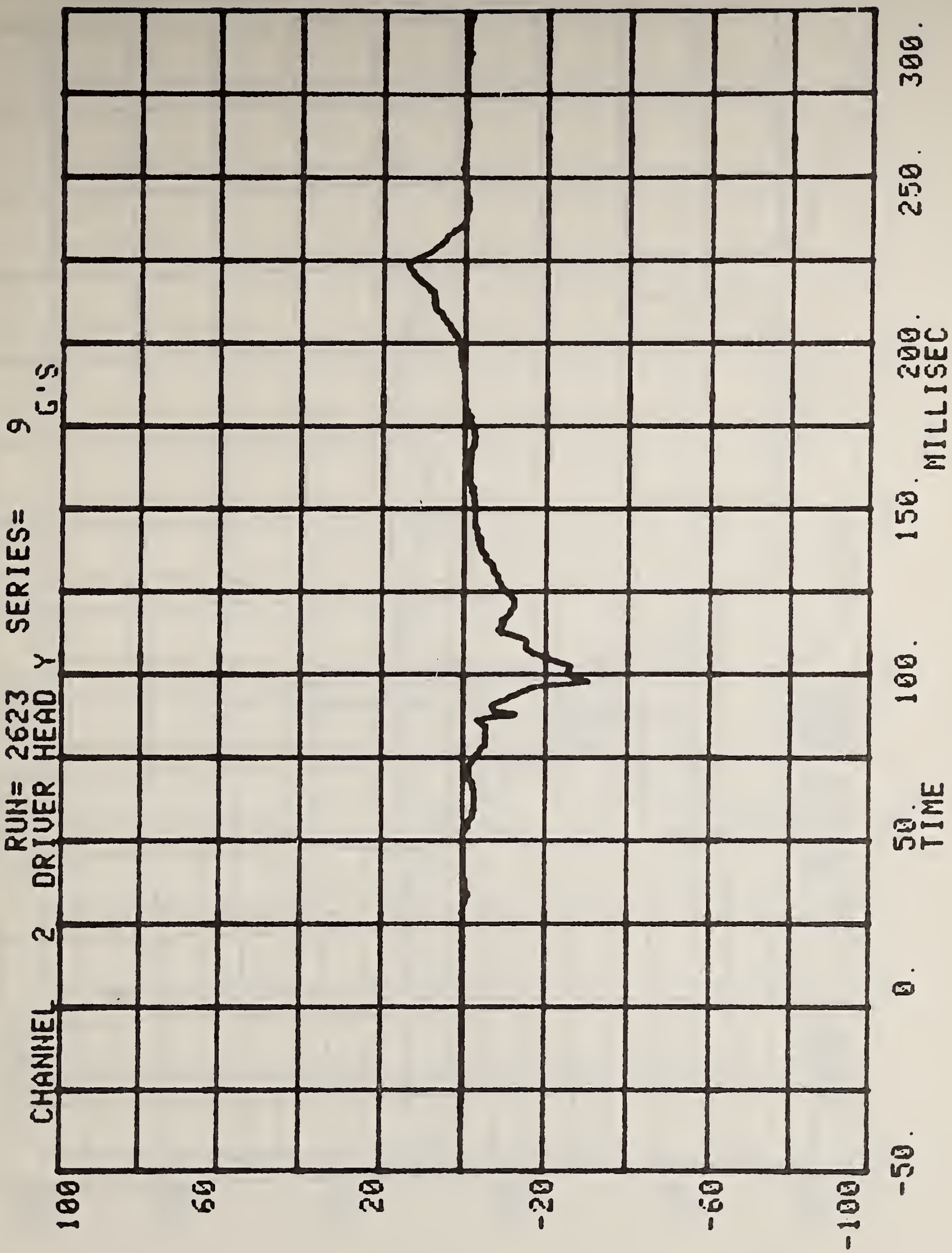
HIC= 402.3   FROM T1= .06180   TO T2= .10740

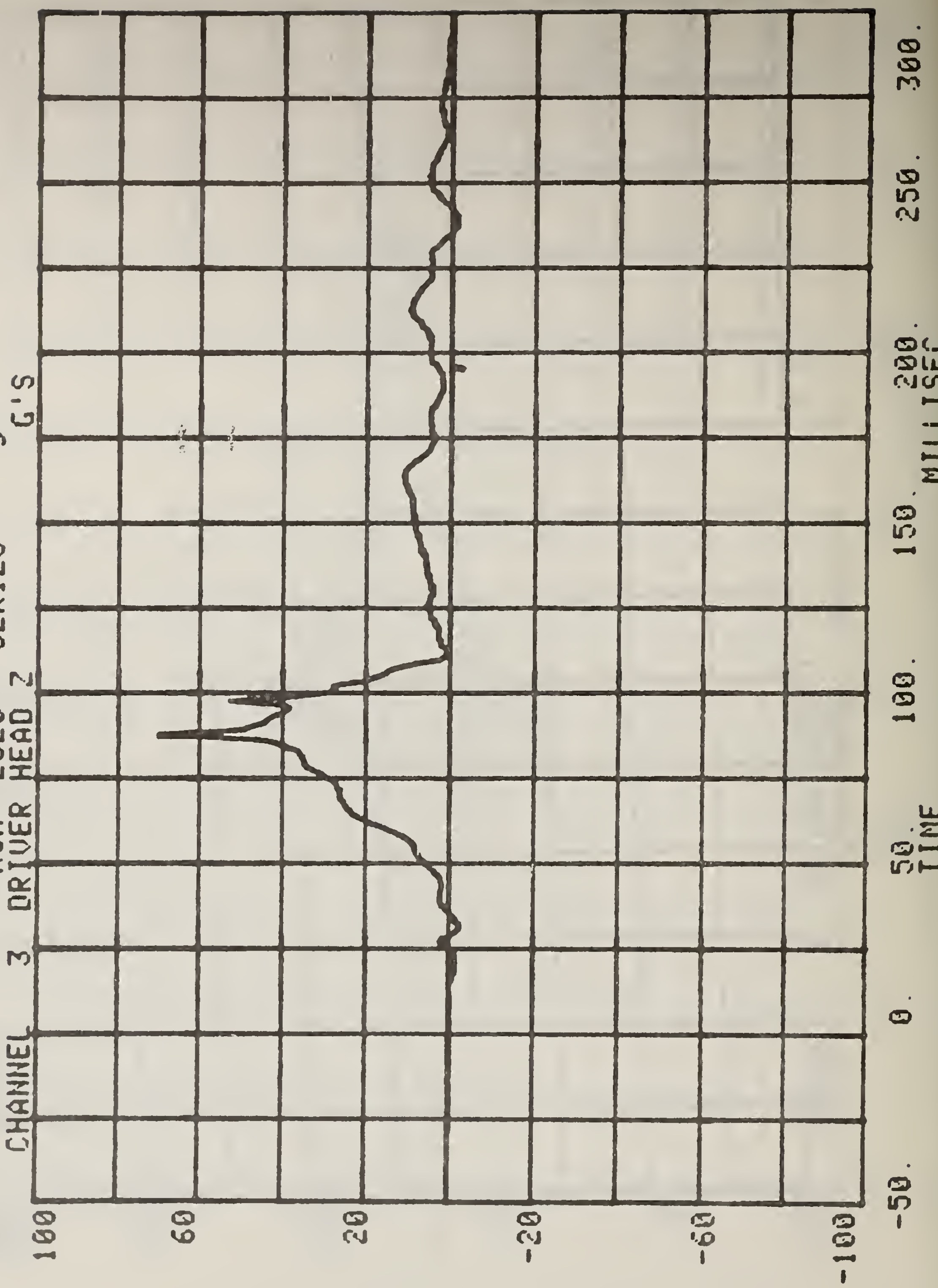
AVERAGE ACCELERATION BETWEEN T1 AND T2= 37.9G'S

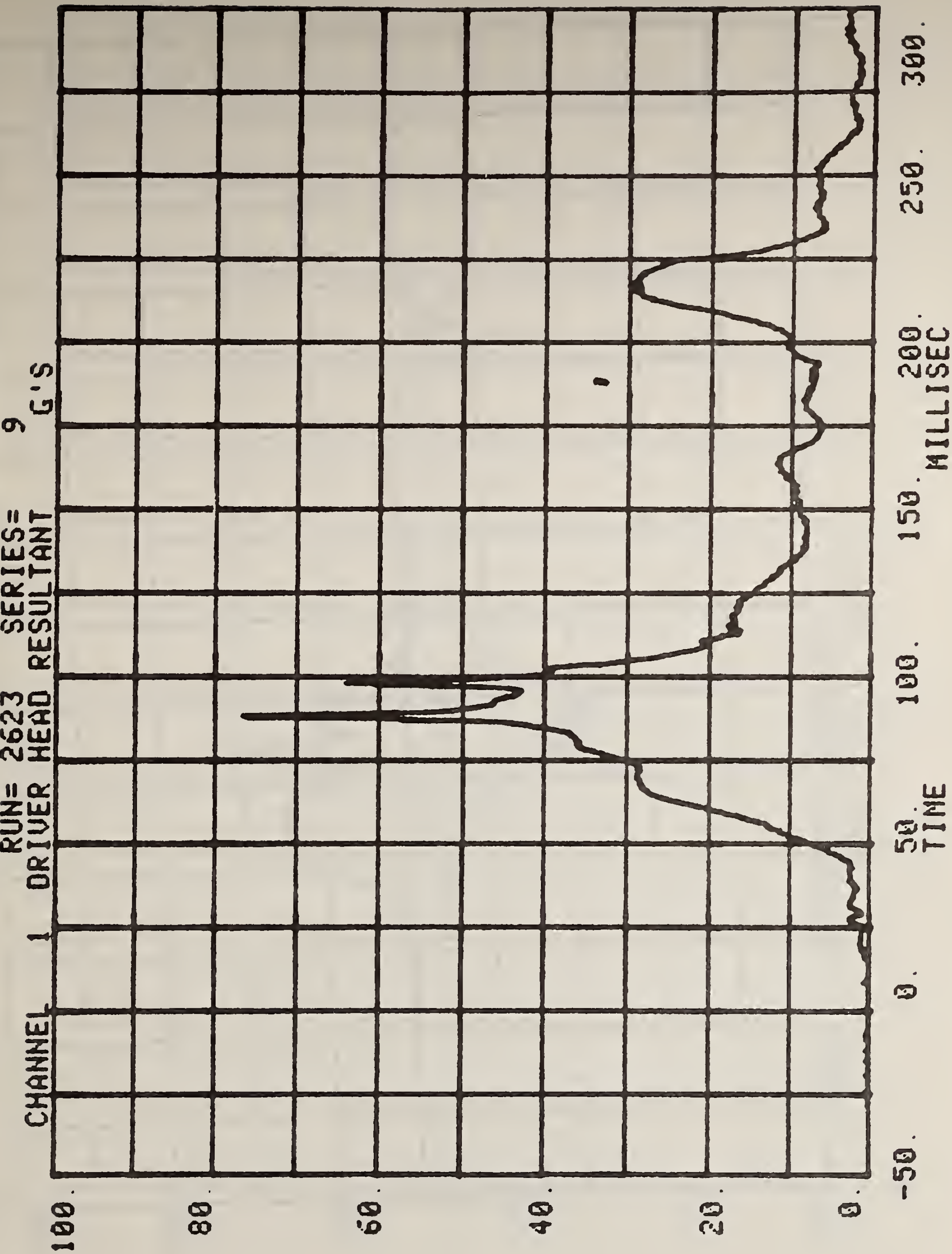
EVENT TIME= 300.0 MSEC

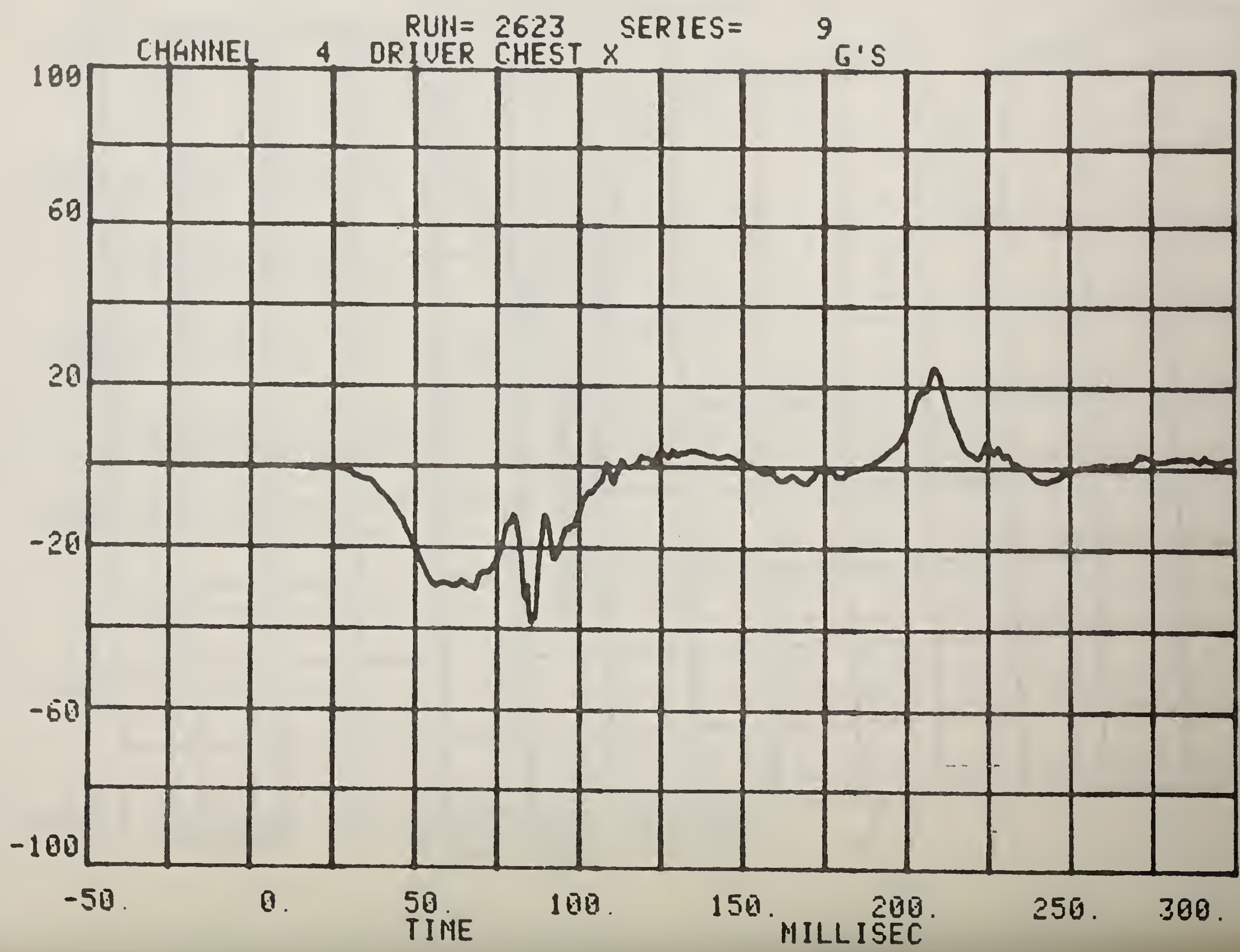
SEVERITY INDEX= 600.7

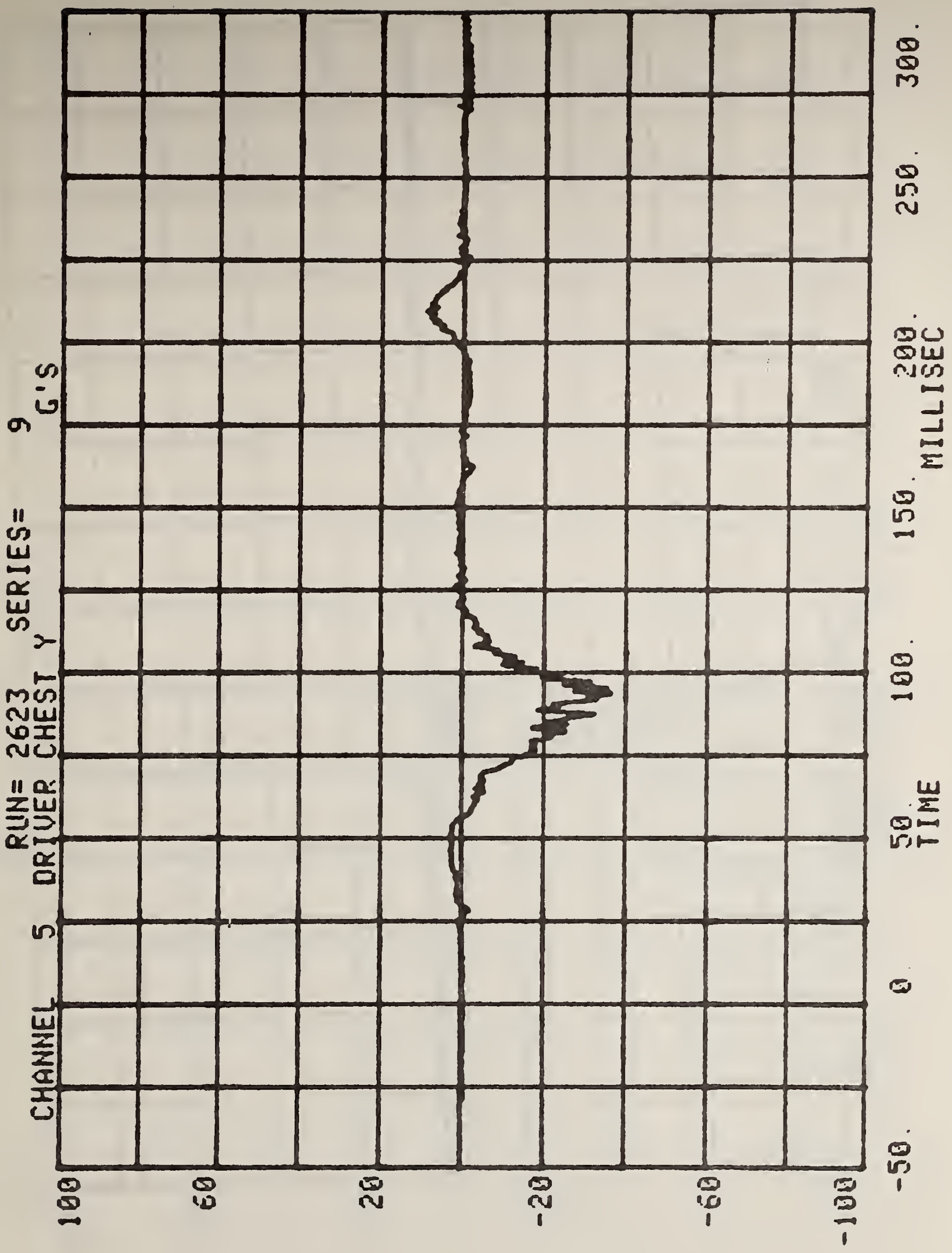

RUN= 2623 SERIES= 9
CHANNEL 1 DRIVER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 2 RUN= 2623 SERIES= 9
DRIVER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

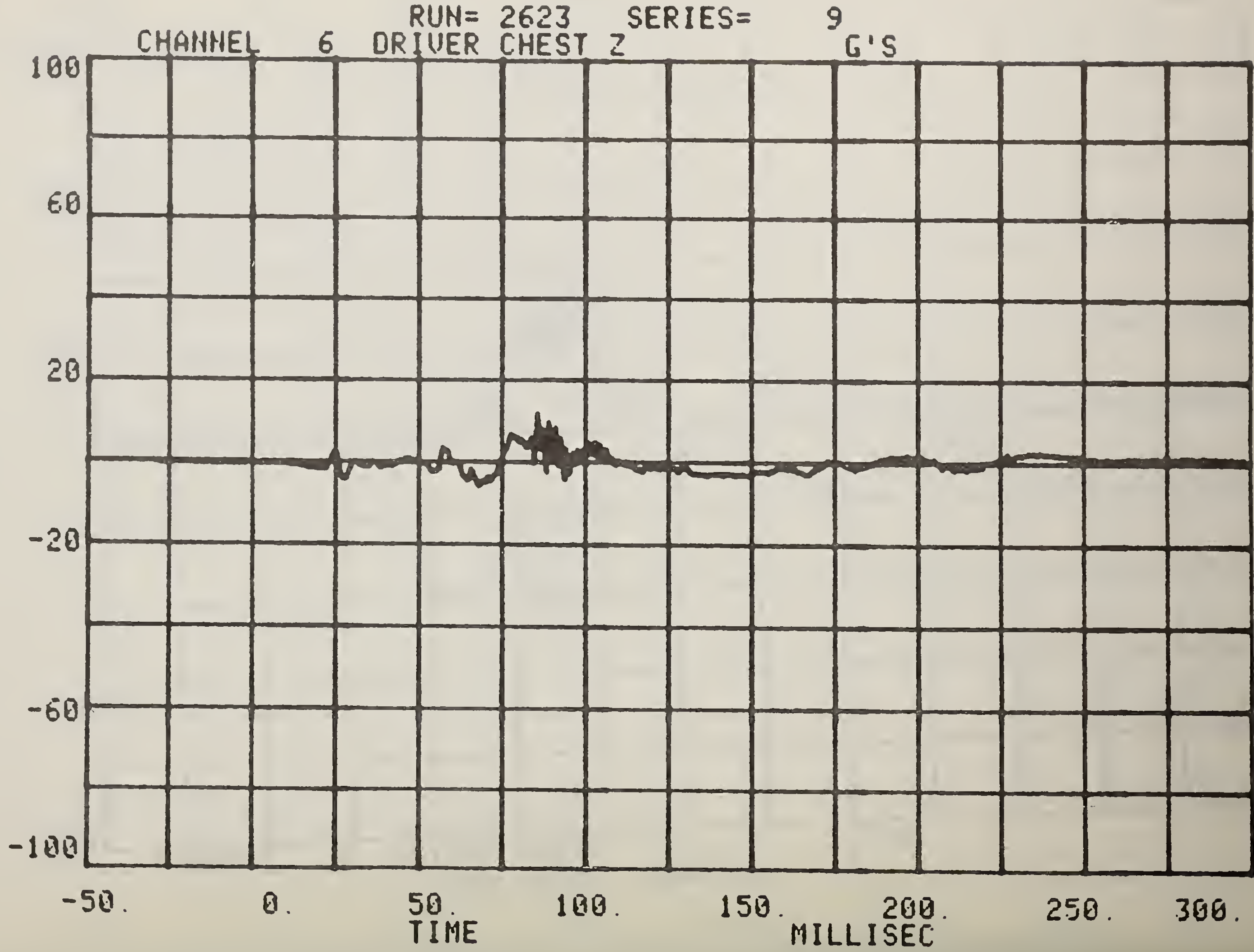

CHANNEL 3 RUN= 2623 SERIES= 9
DRIVER HEAD Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

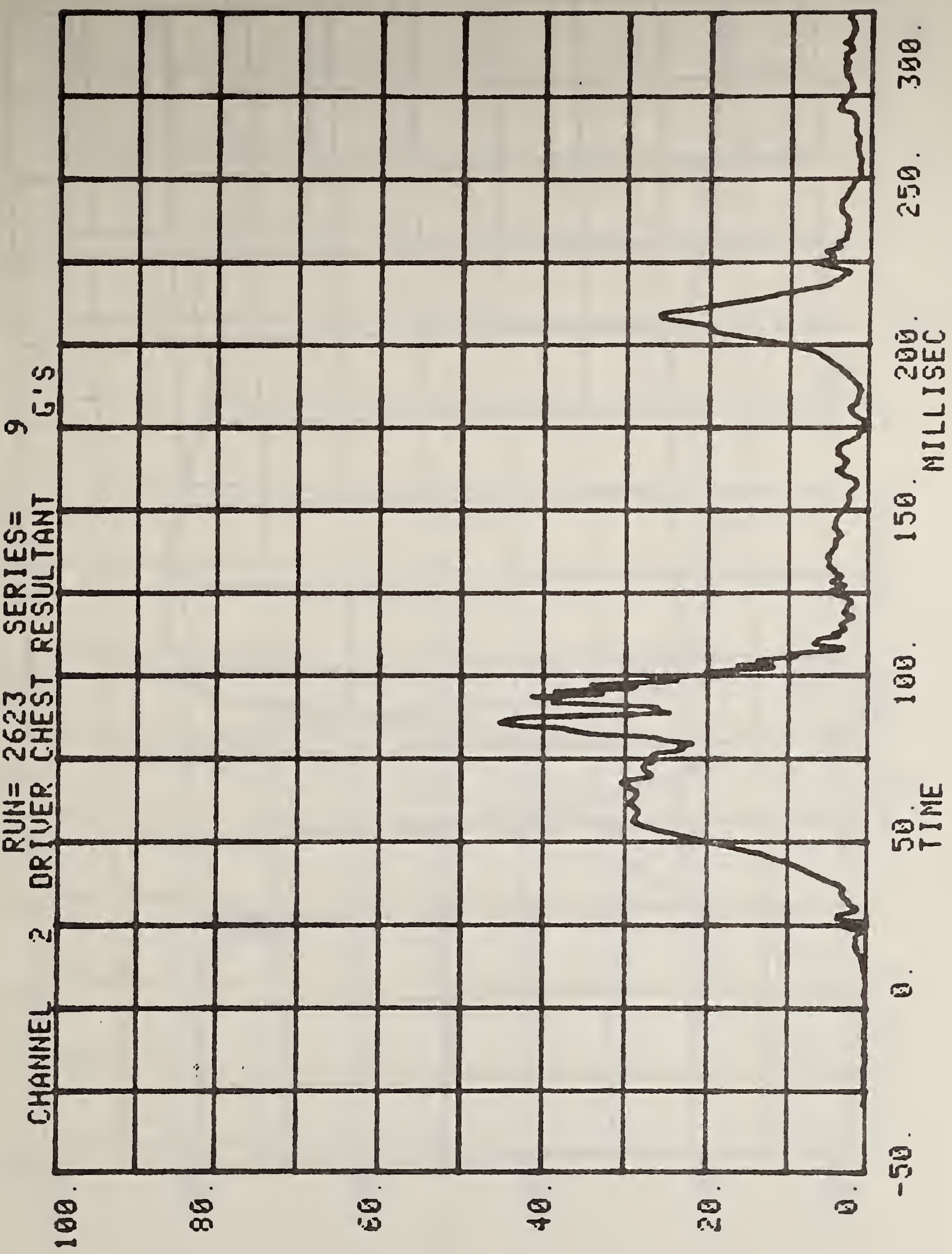

CHANNEL 1 RUN= 2623 SERIES= 9
DRIVER HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

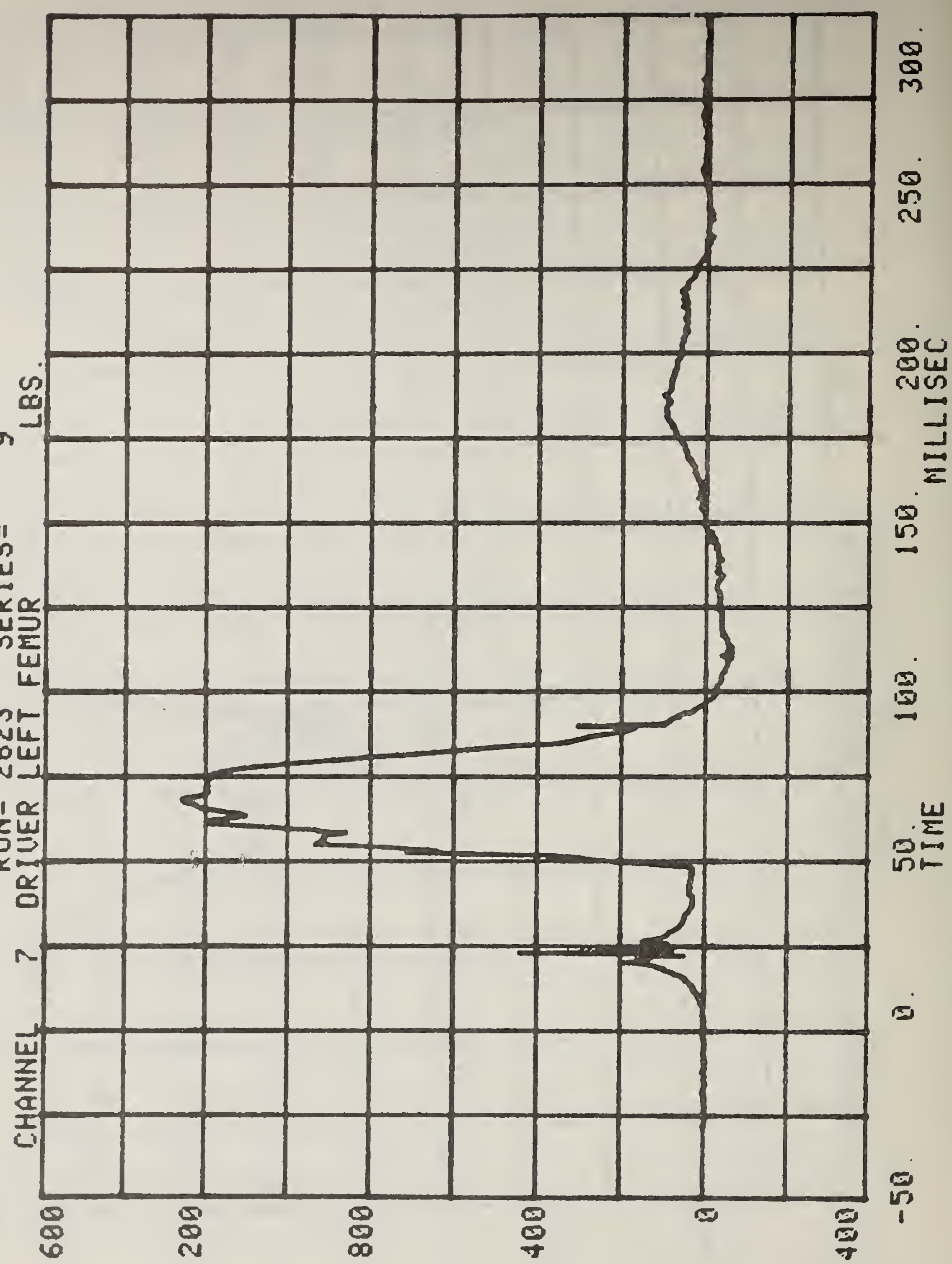

RUN= 2623 SERIES= 9
CHANNEL 4 DRIVER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

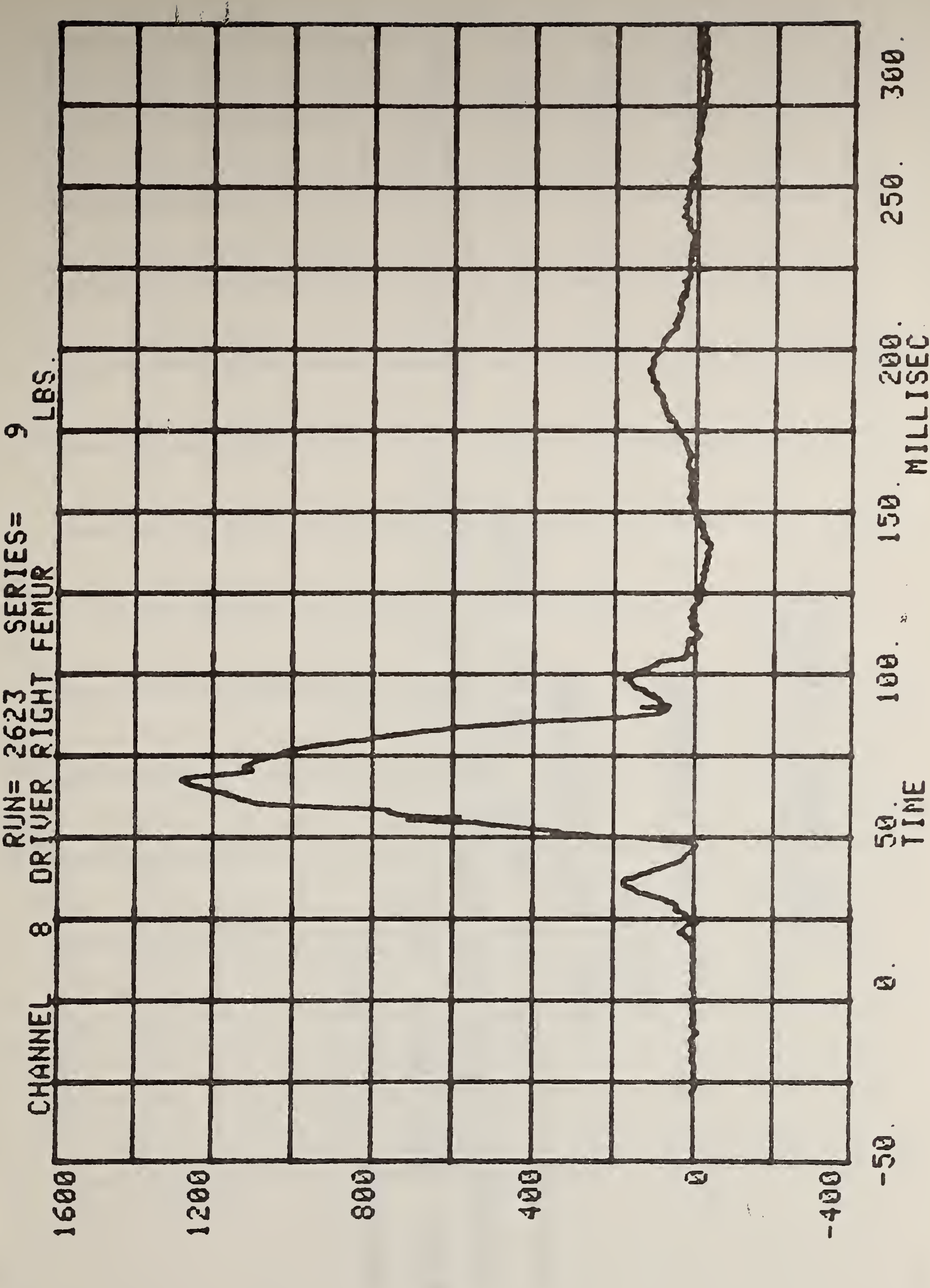


CHANNEL 5 RUN= 2623 SERIES= 9
DRIVER CHEST Y
G'S
100
60
20
-20
-60
-100
-50.
0
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2623 SERIES= 9
CHANNEL 6 DRIVER CHEST Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 2 RUN= 2623 SERIES= 9
DRIVER CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 7 RUN= 2623 SERIES= 9
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



CHANNEL 8 RUN= 2623 SERIES= 9
DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2623

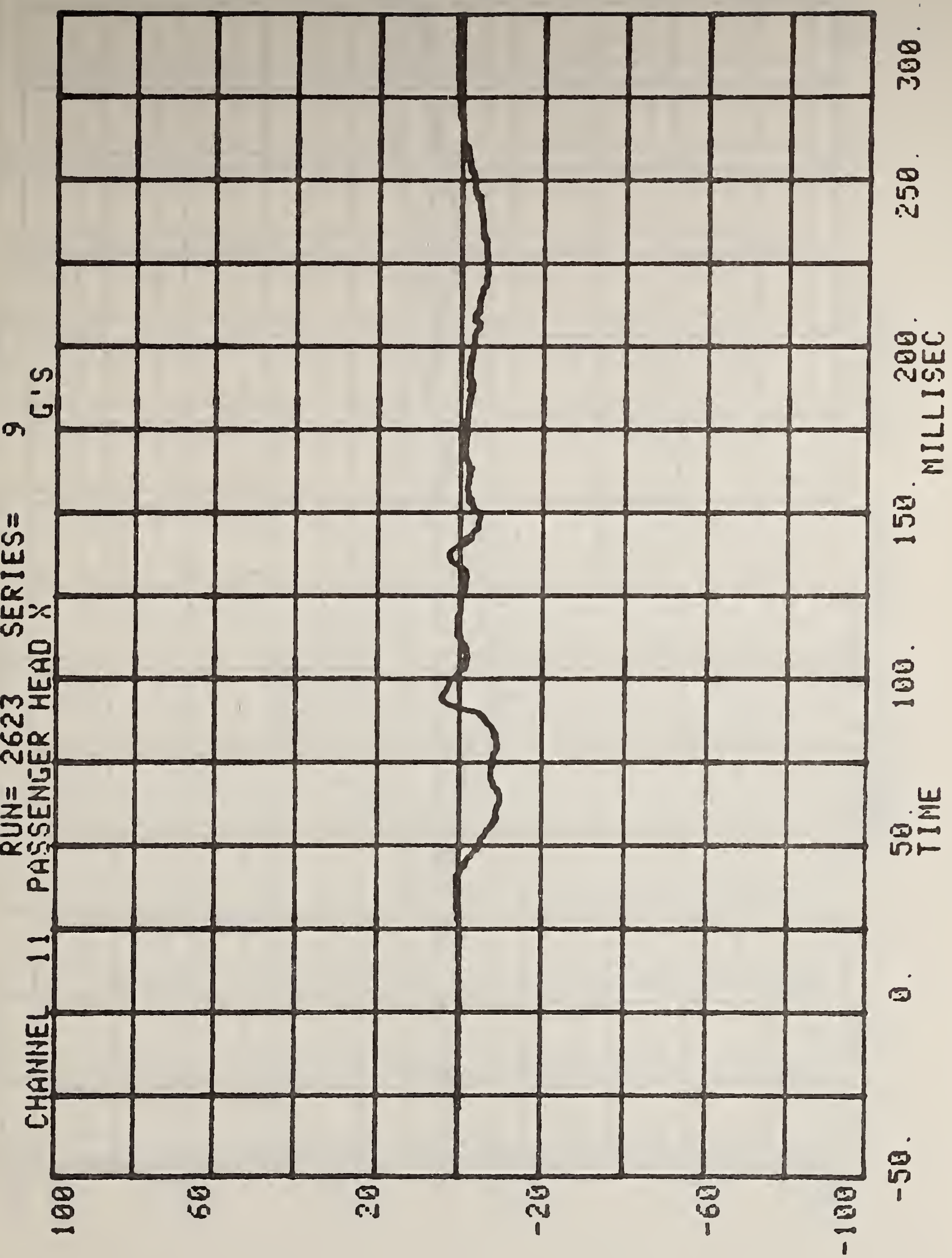
PASS. HEAD RESULTANT

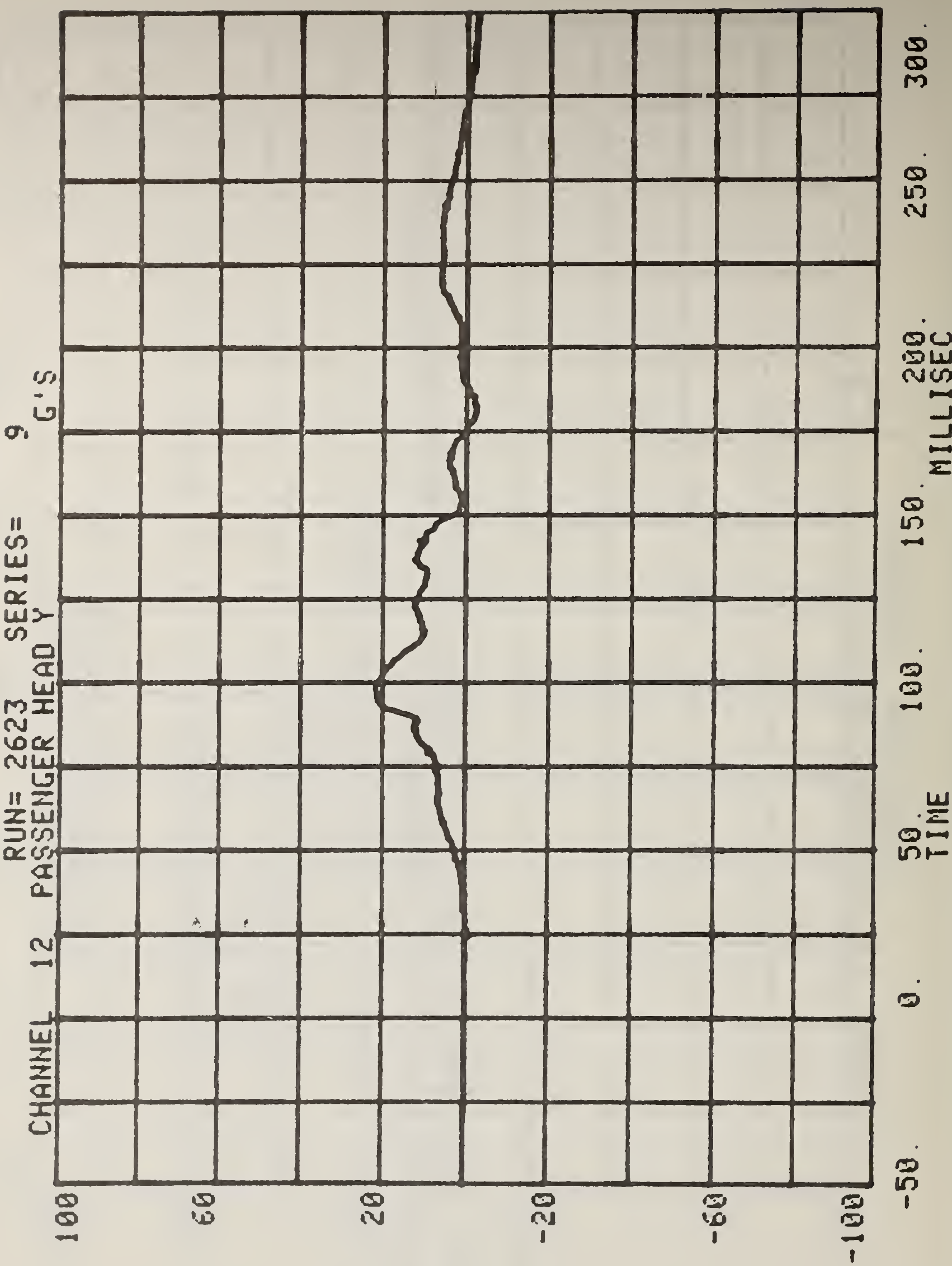
HIC= 209.3 FROM T1= .06030 TO T2= .10950

AVERAGE ACCELERATION BETWEEN T1 AND T2= 28.3G'S

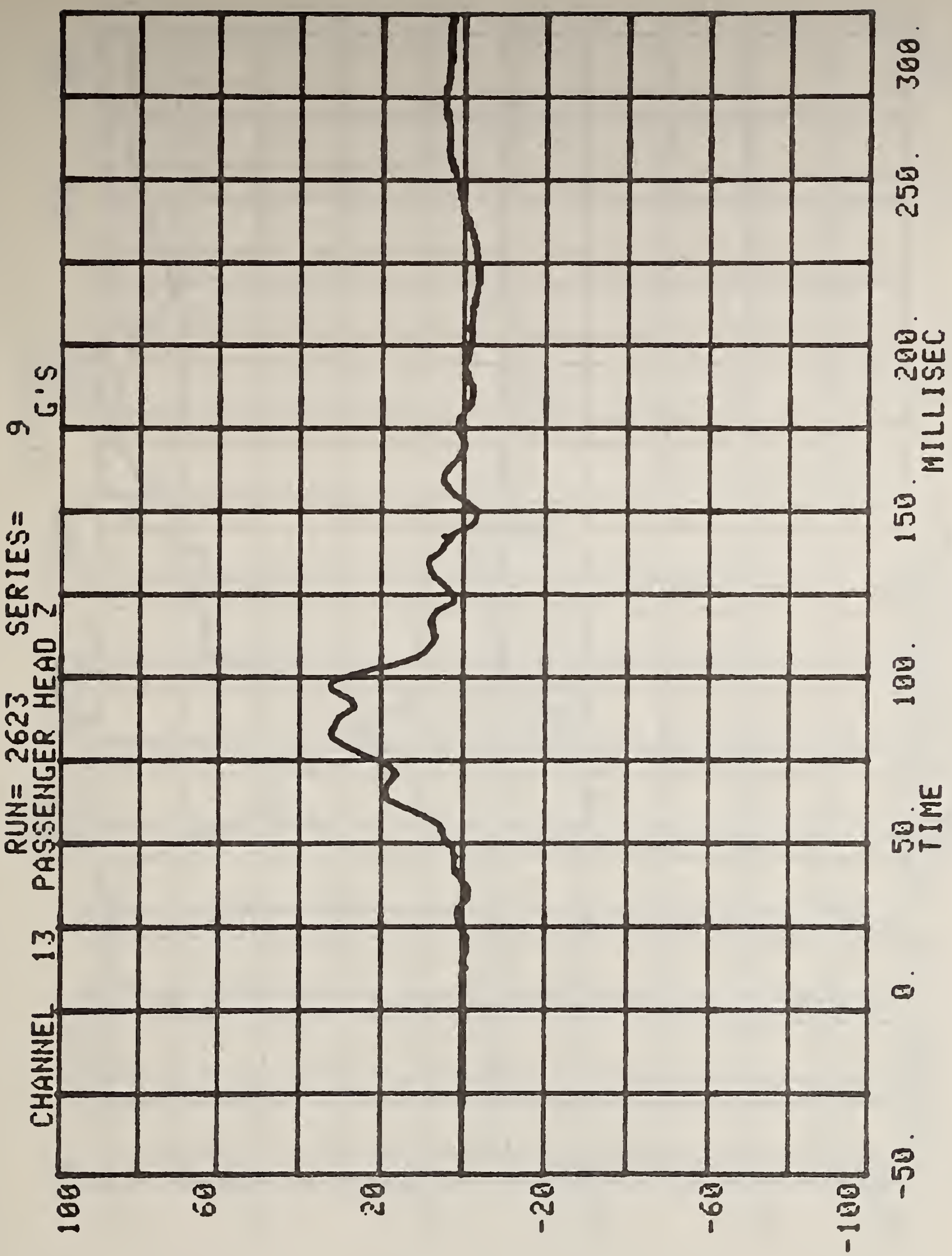
EVENT TIME= 300.0 MSEC

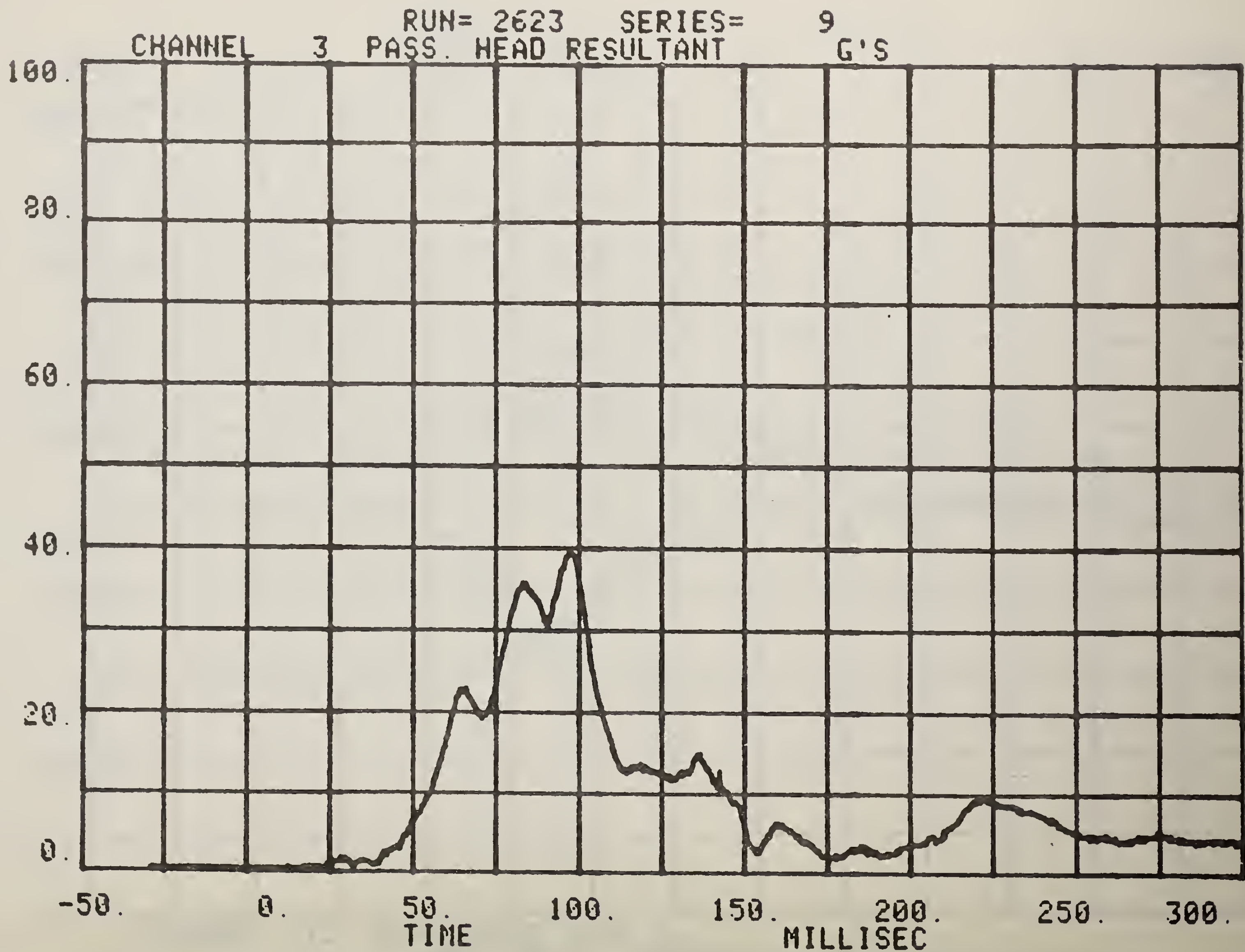
SEVERITY INDEX= 271.2

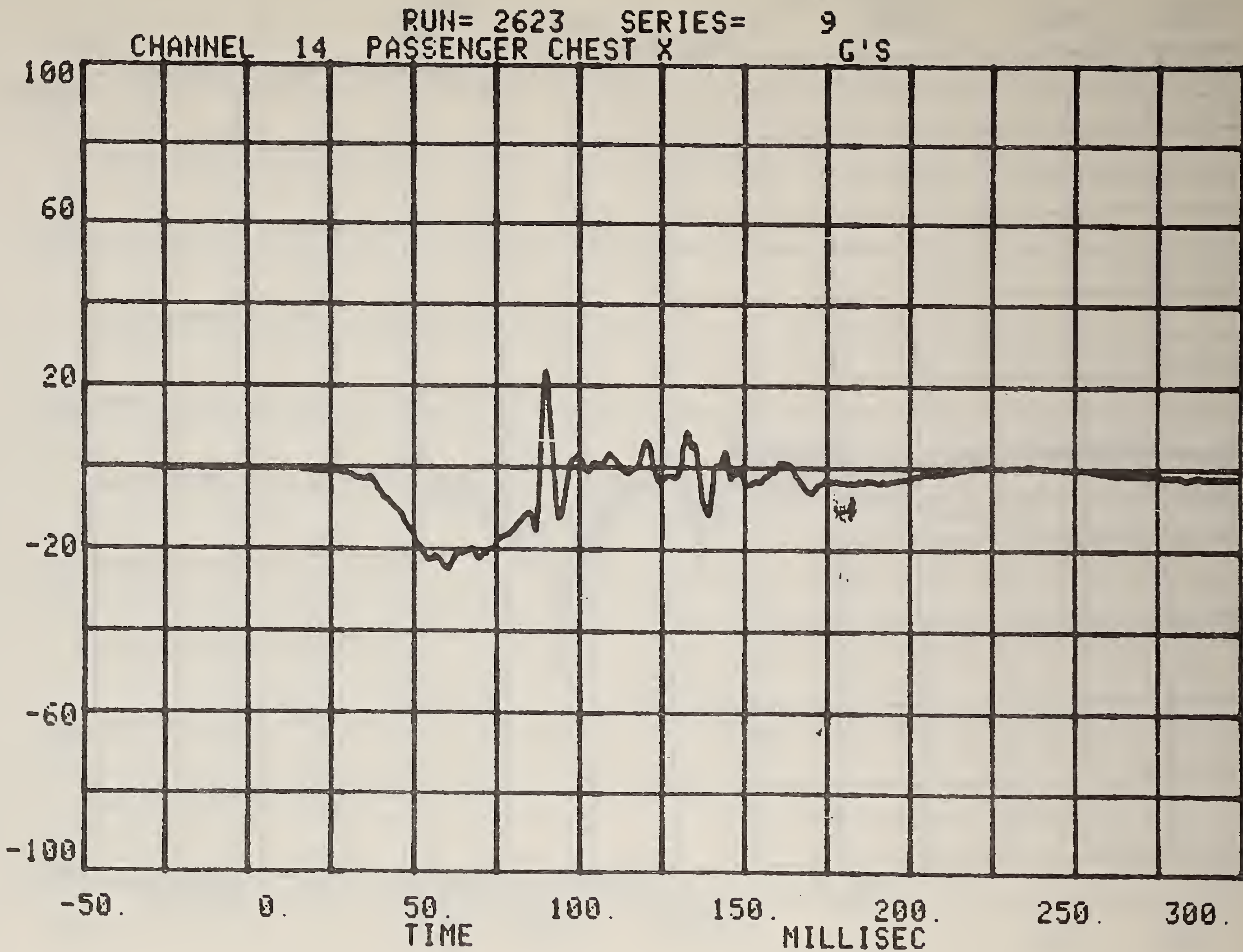

CHANNEL 11 RUN= 2623 SERIES= 9
PASSENGER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

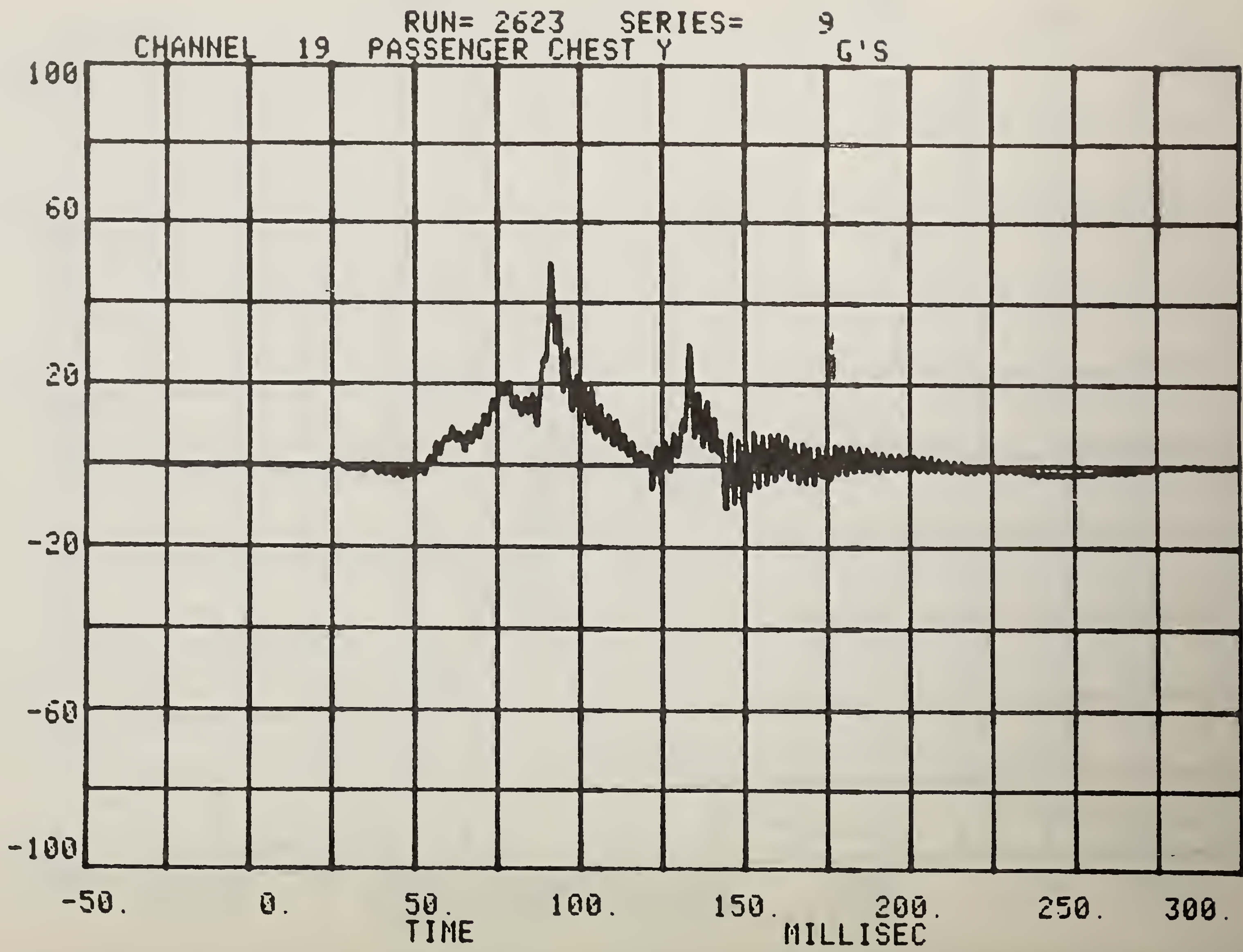


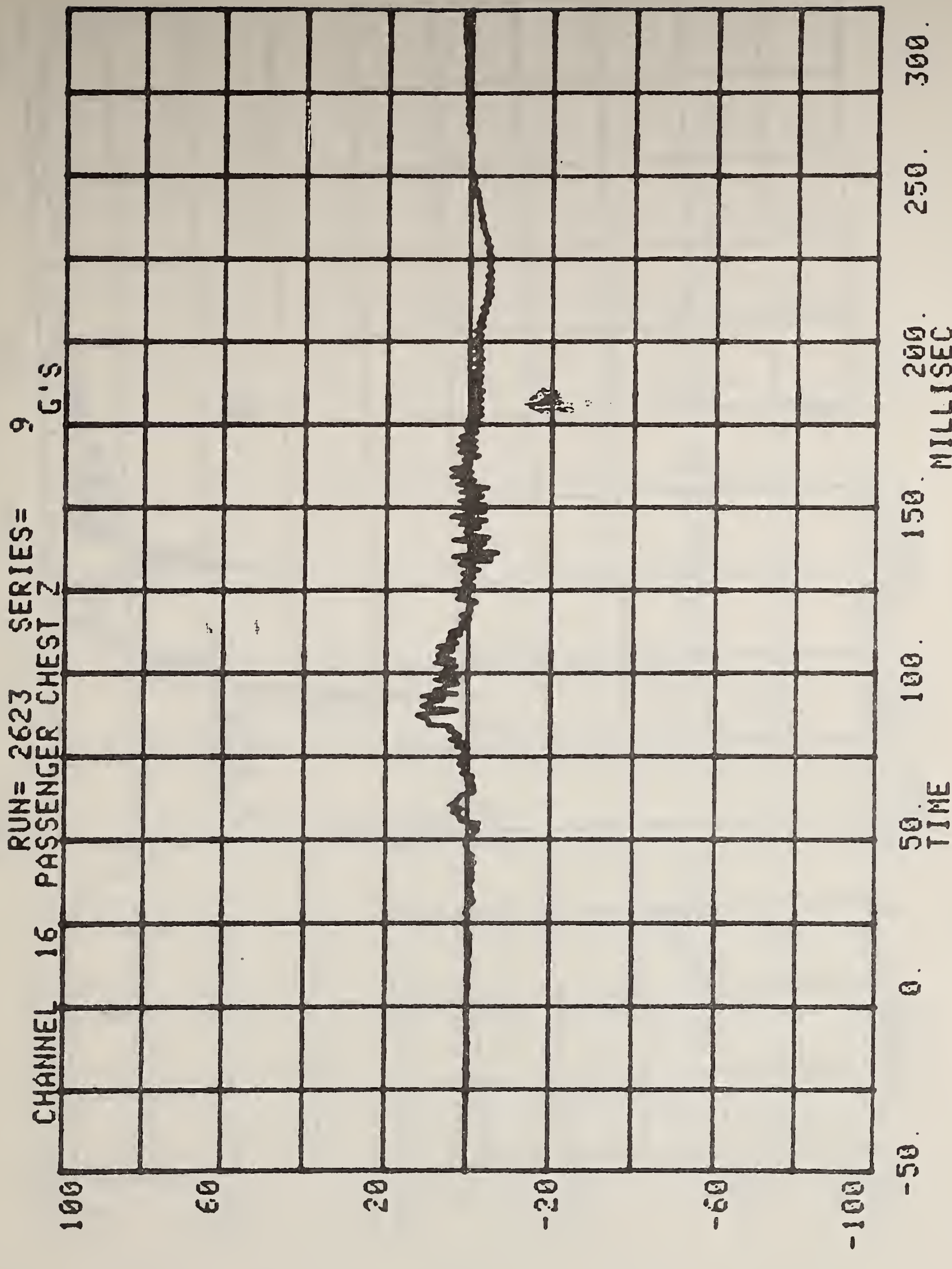
CHANNEL 12 RUN= 2623 SERIES= 9
PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

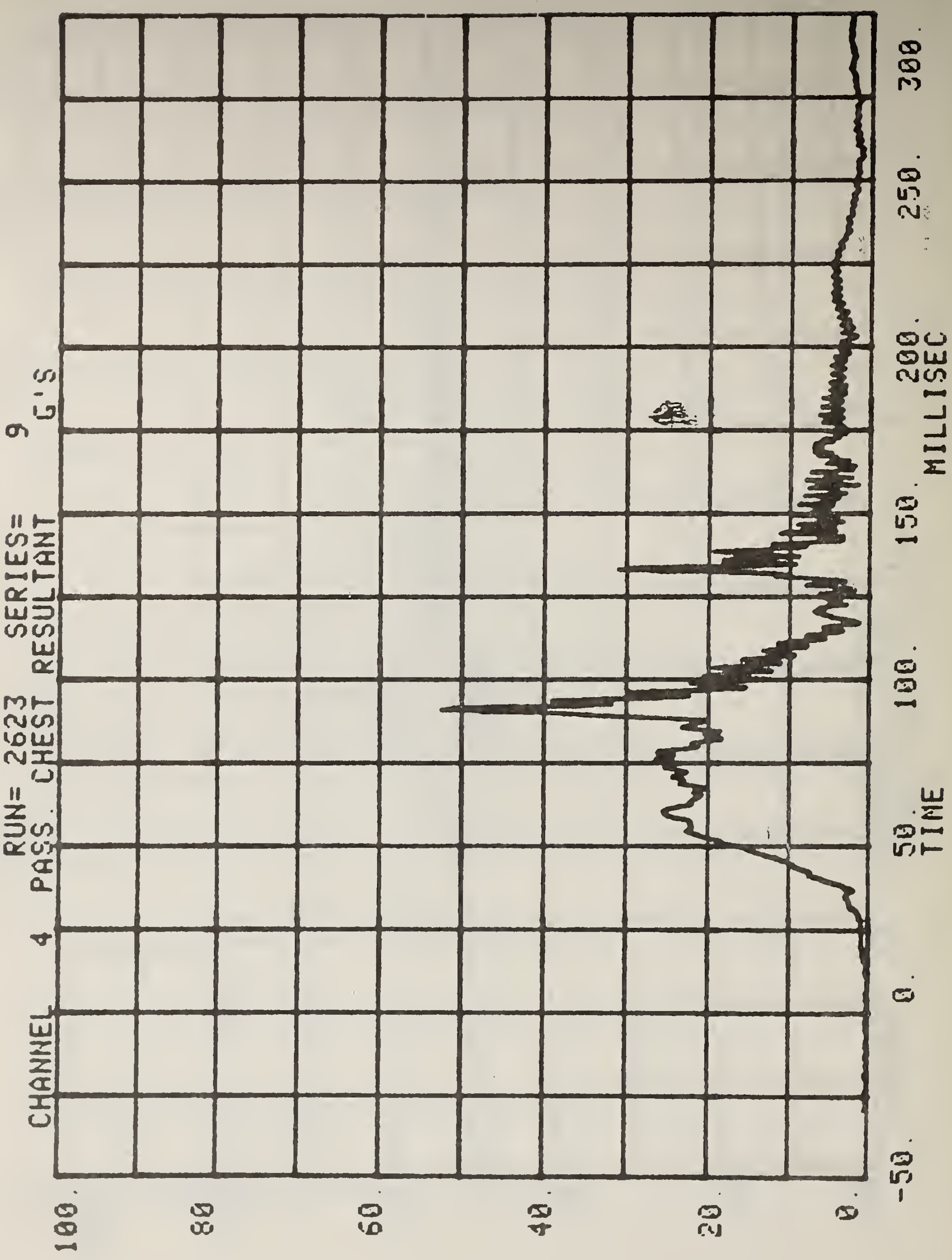

CHANNEL 13 RUN= 2623 SERIES= 9
PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

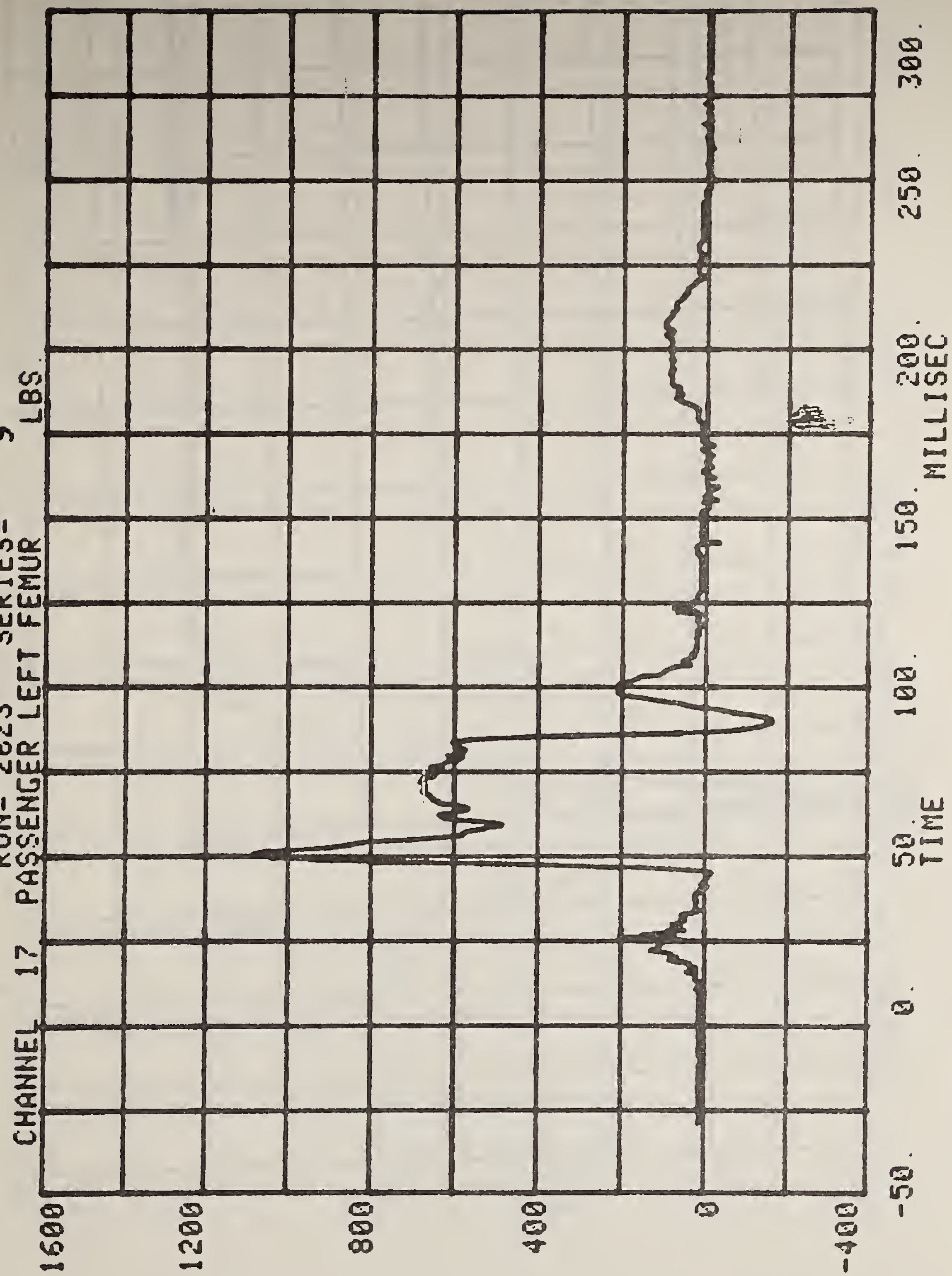

RUN= 2623 SERIES= 9
CHANNEL 3 PASS. HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

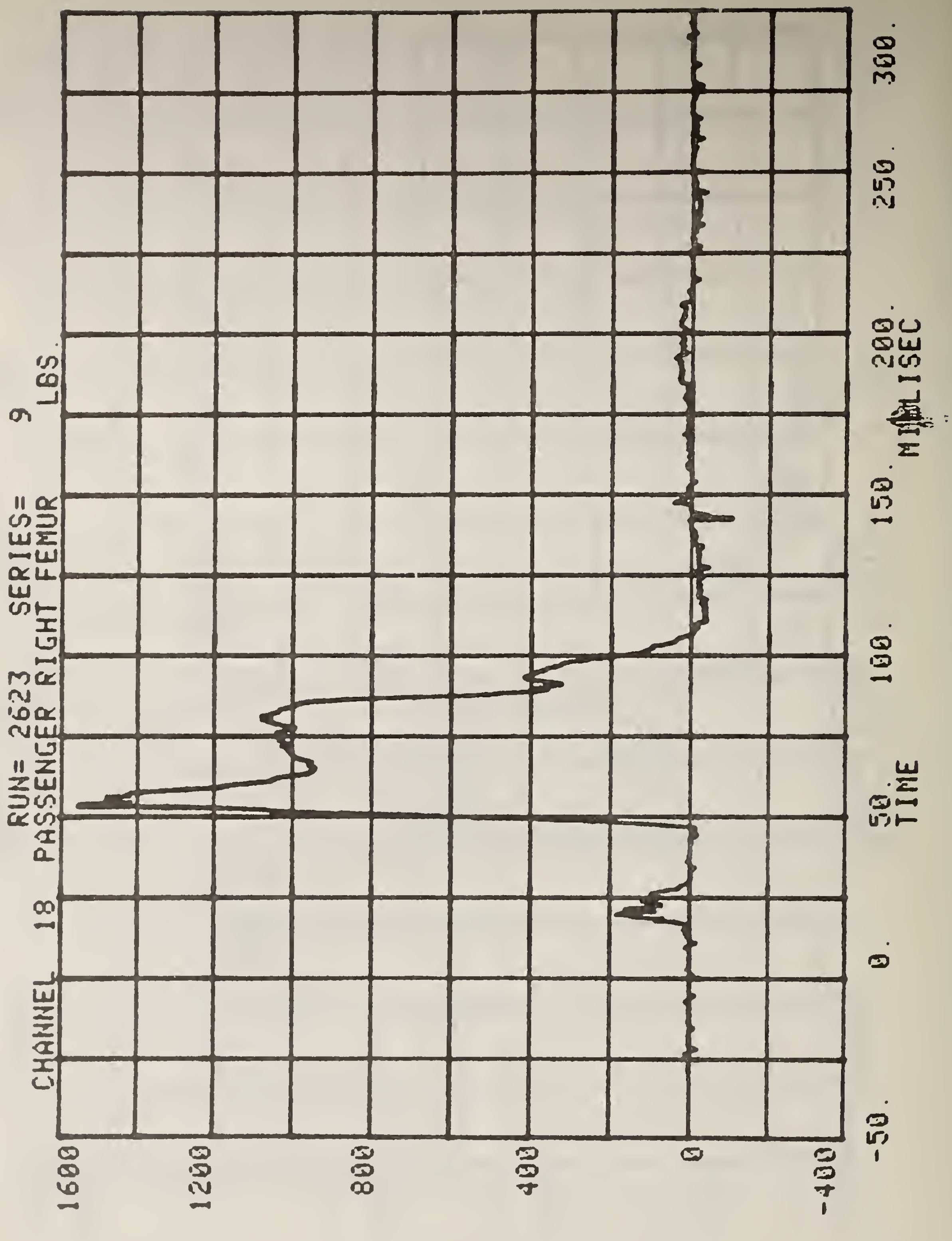

RUN= 2623 SERIES= 9
CHANNEL 14 PASSENGER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2623 SERIES= 9
CHANNEL 19 PASSENGER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

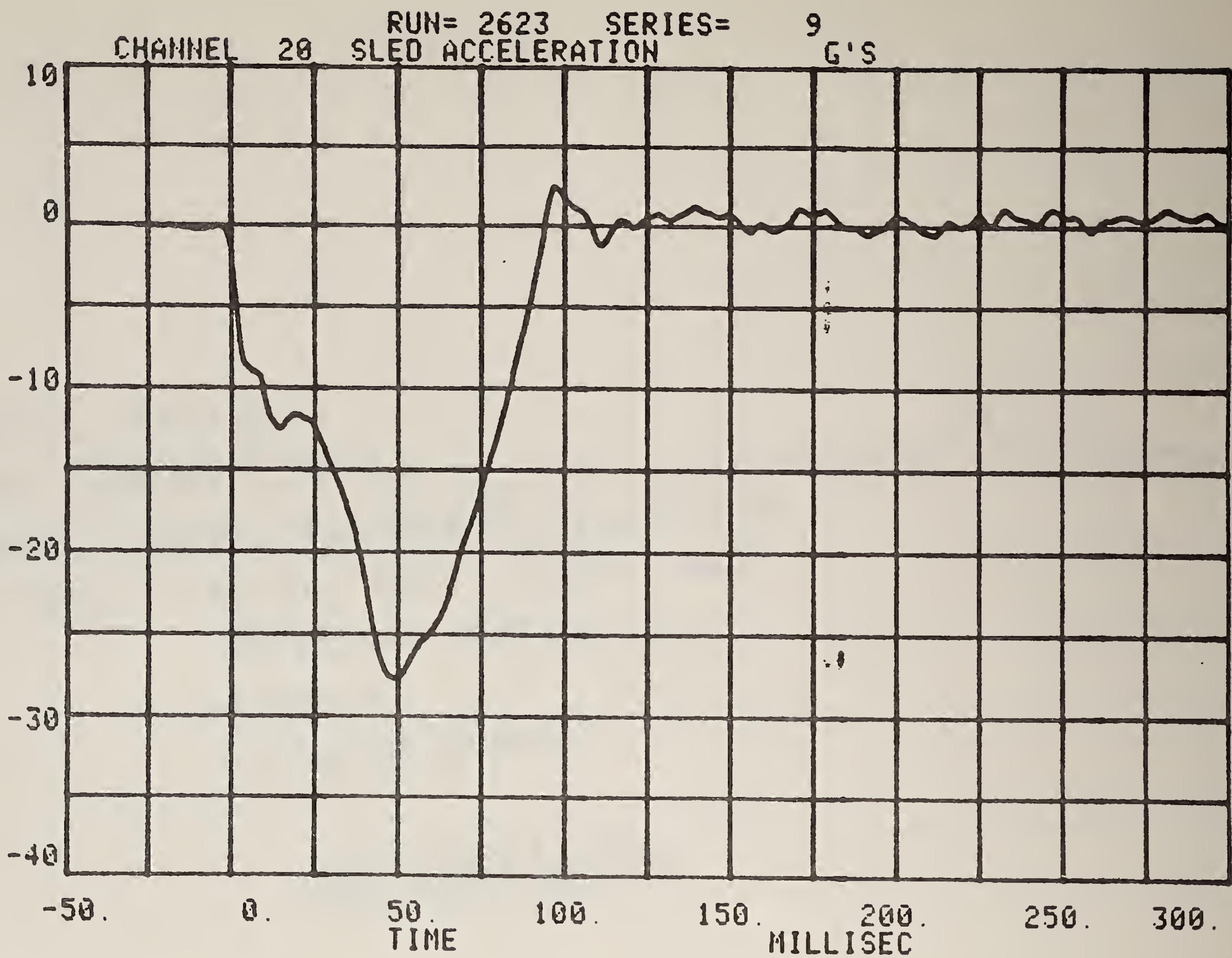

CHANNEL 16 RUN= 2623 SERIES= 9
PASSENGER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 4 RUN= 2623 SERIES= 9
PASS. CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 17 RUN= 2623 SERIES= 9
PASSENGER LEFT FEMUR LBS
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



CHANNEL 18 RUN= 2623 SERIES= 9
PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2623 SERIES= 9
CHANNEL 20 SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2624

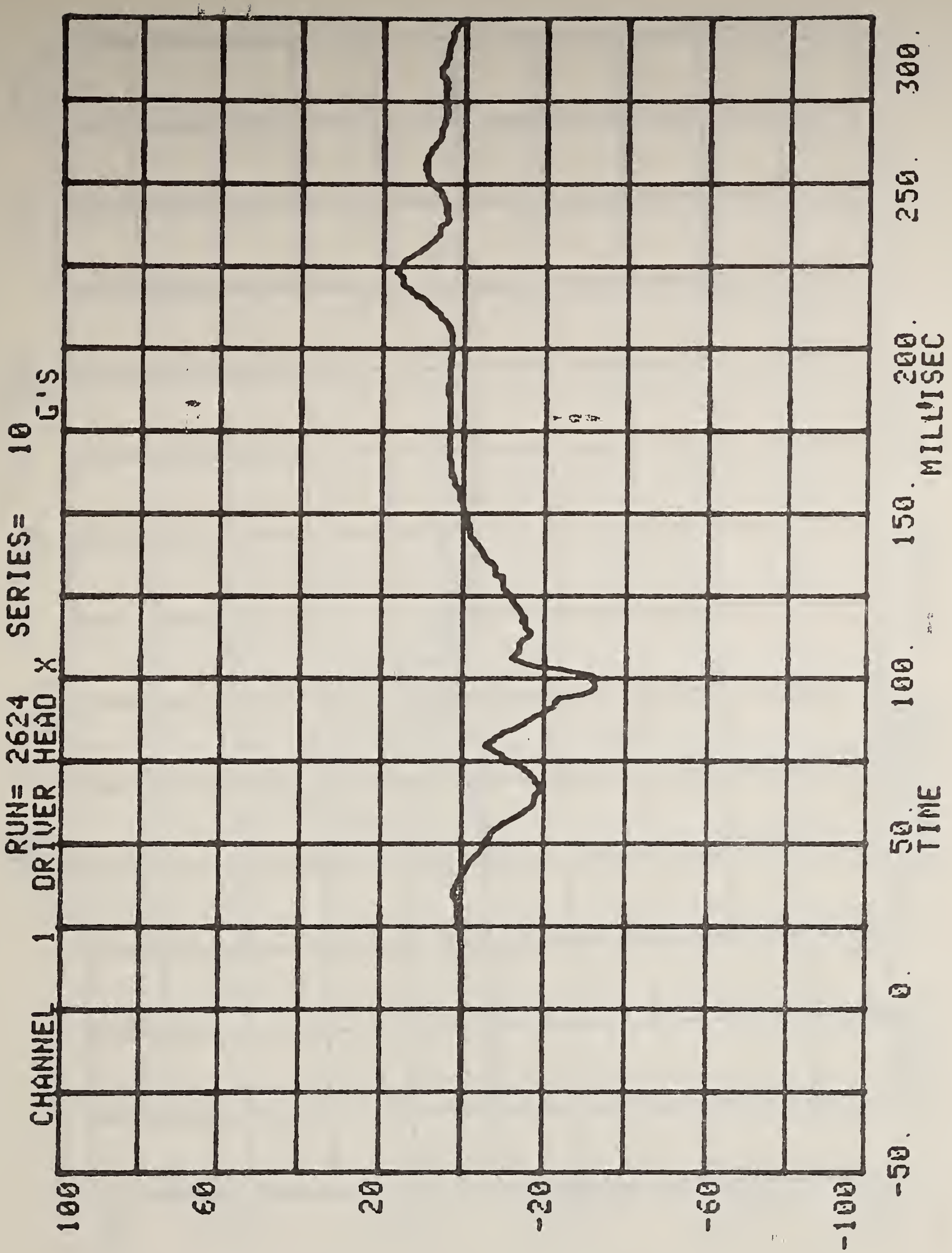
DRIVER HEAD RESULTANT

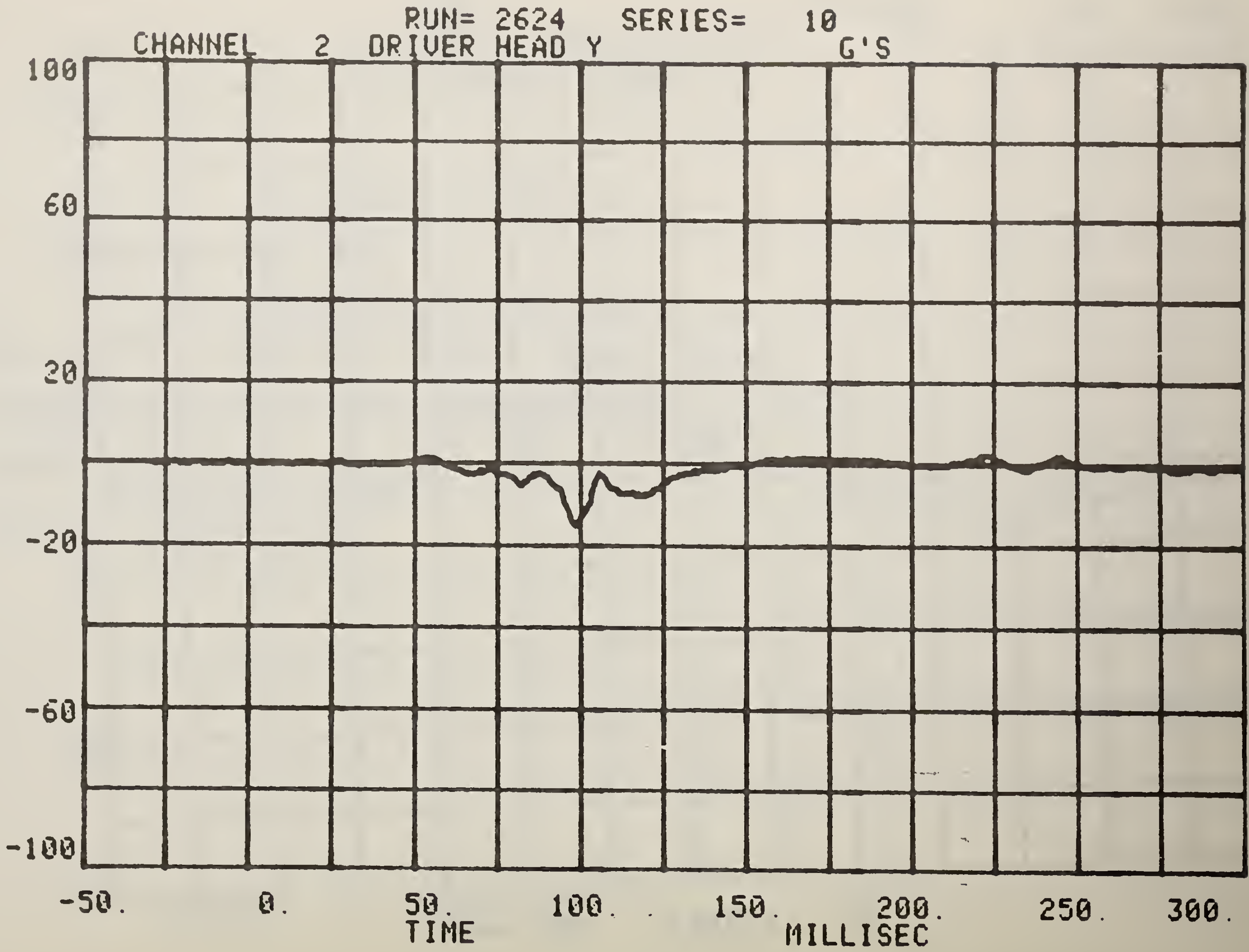
HIC= 413.6   FROM T1= .05910   TO T2= .10920

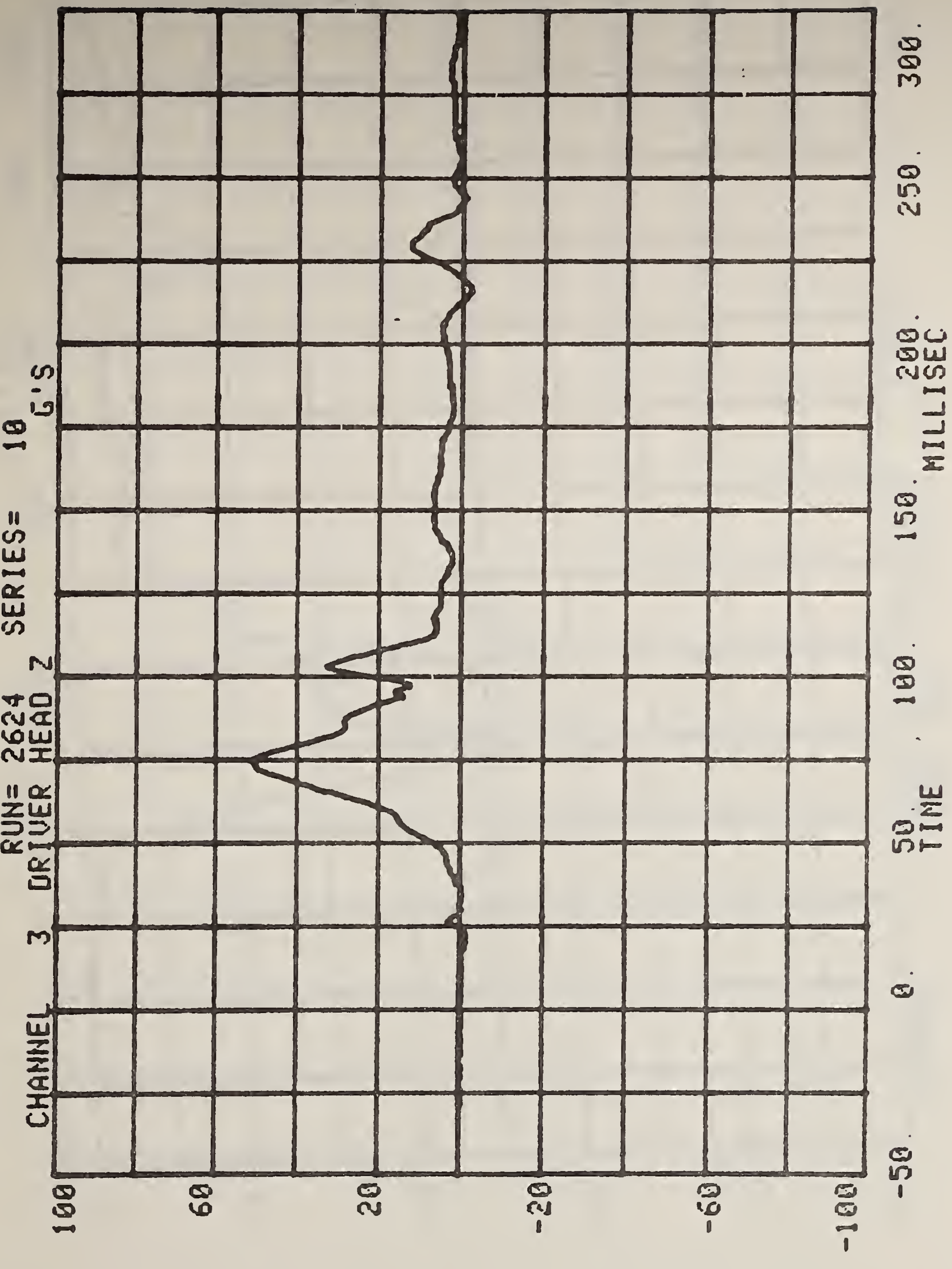
AVERAGE ACCELERATION BETWEEN T1 AND T2= 36.9G'S

EVENT TIME= 300.0 MSEC

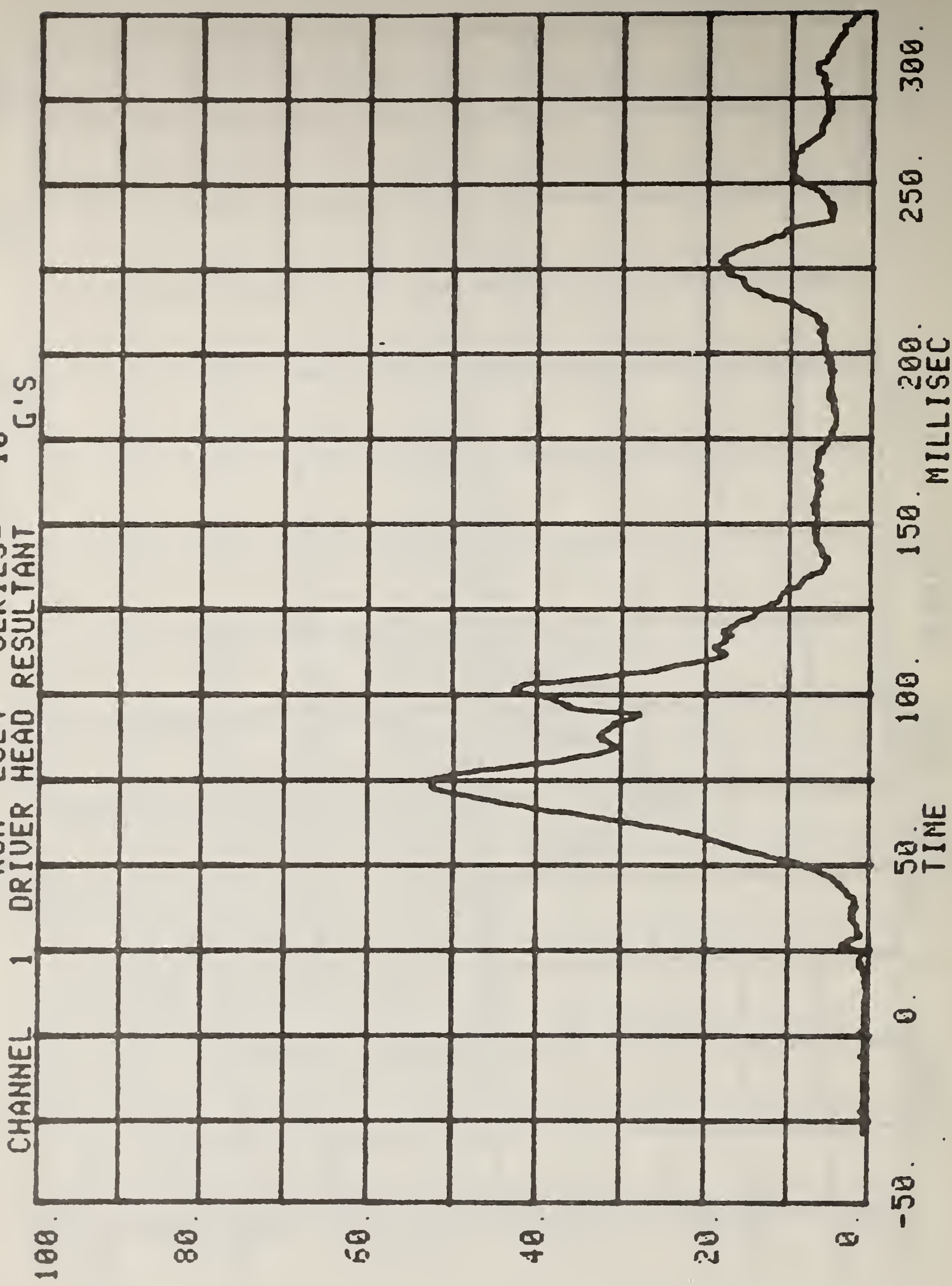
SEVERITY INDEX= 522.5

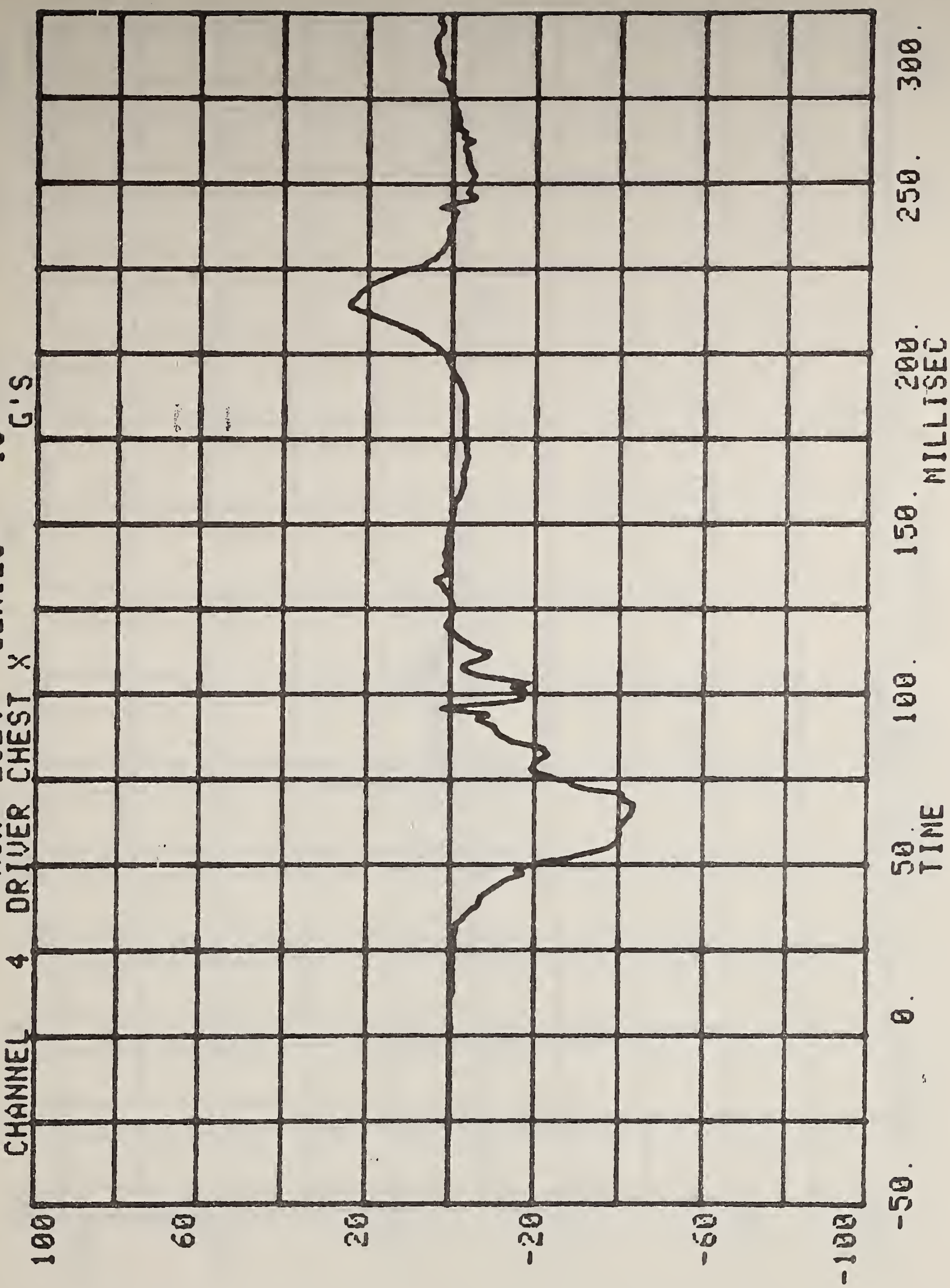

CHANNEL 1 RUN= 2624 SERIES= 10
DRIVER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

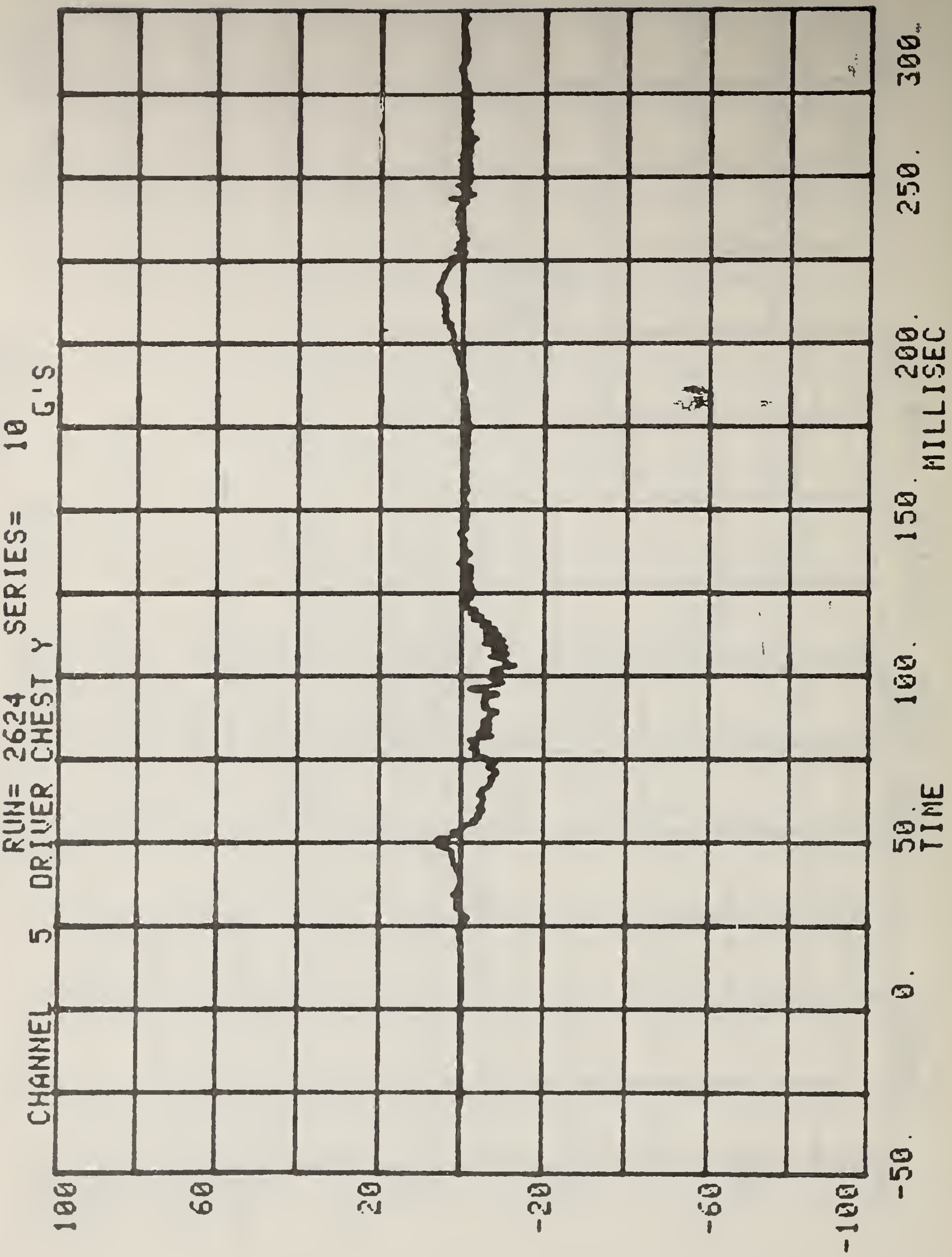

RUN= 2624 SERIES= 10
CHANNEL 2 DRIVER HEAD Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC



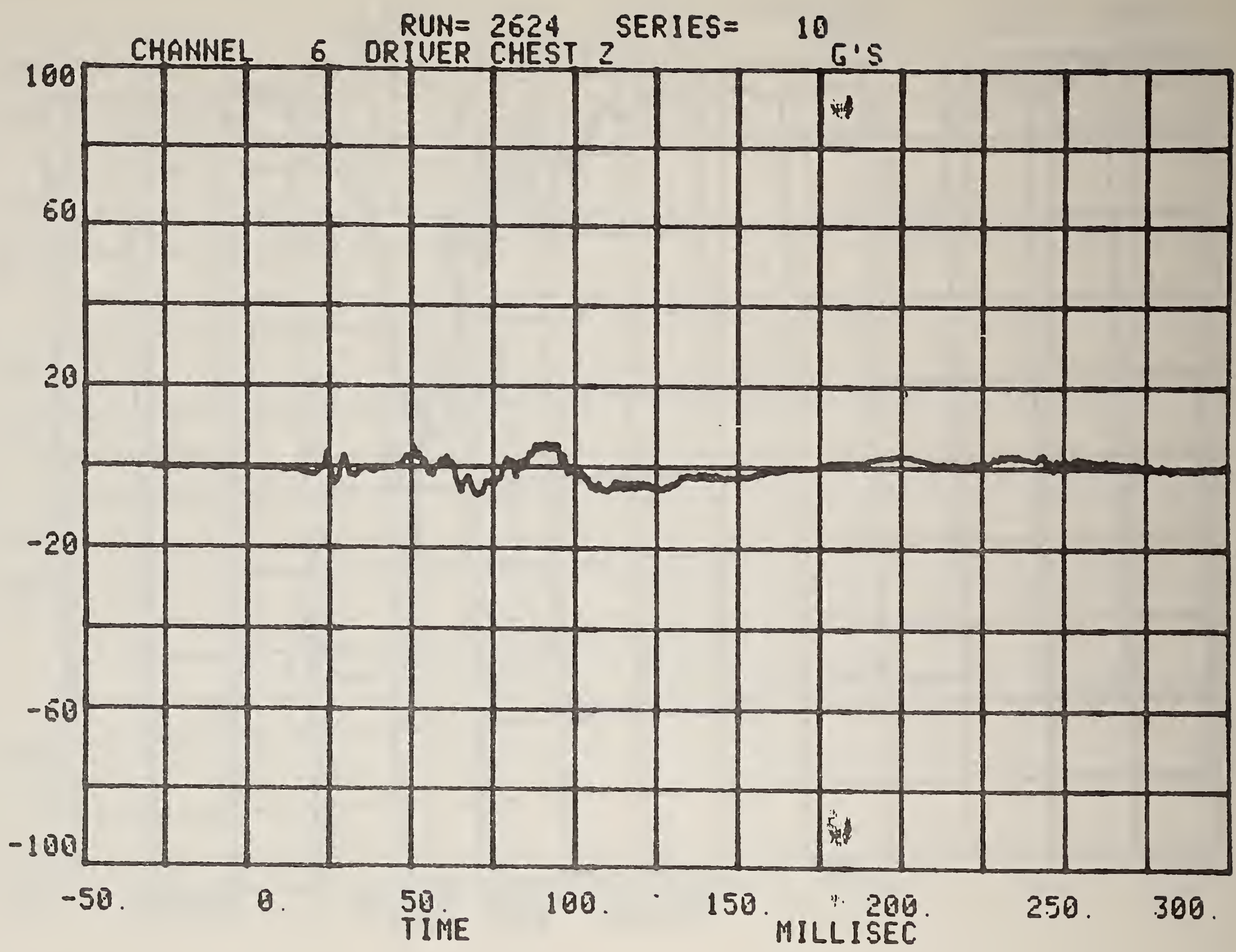
CHANNEL 3 RUN= 2624 SERIES= 10
DRIVER HEAD Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

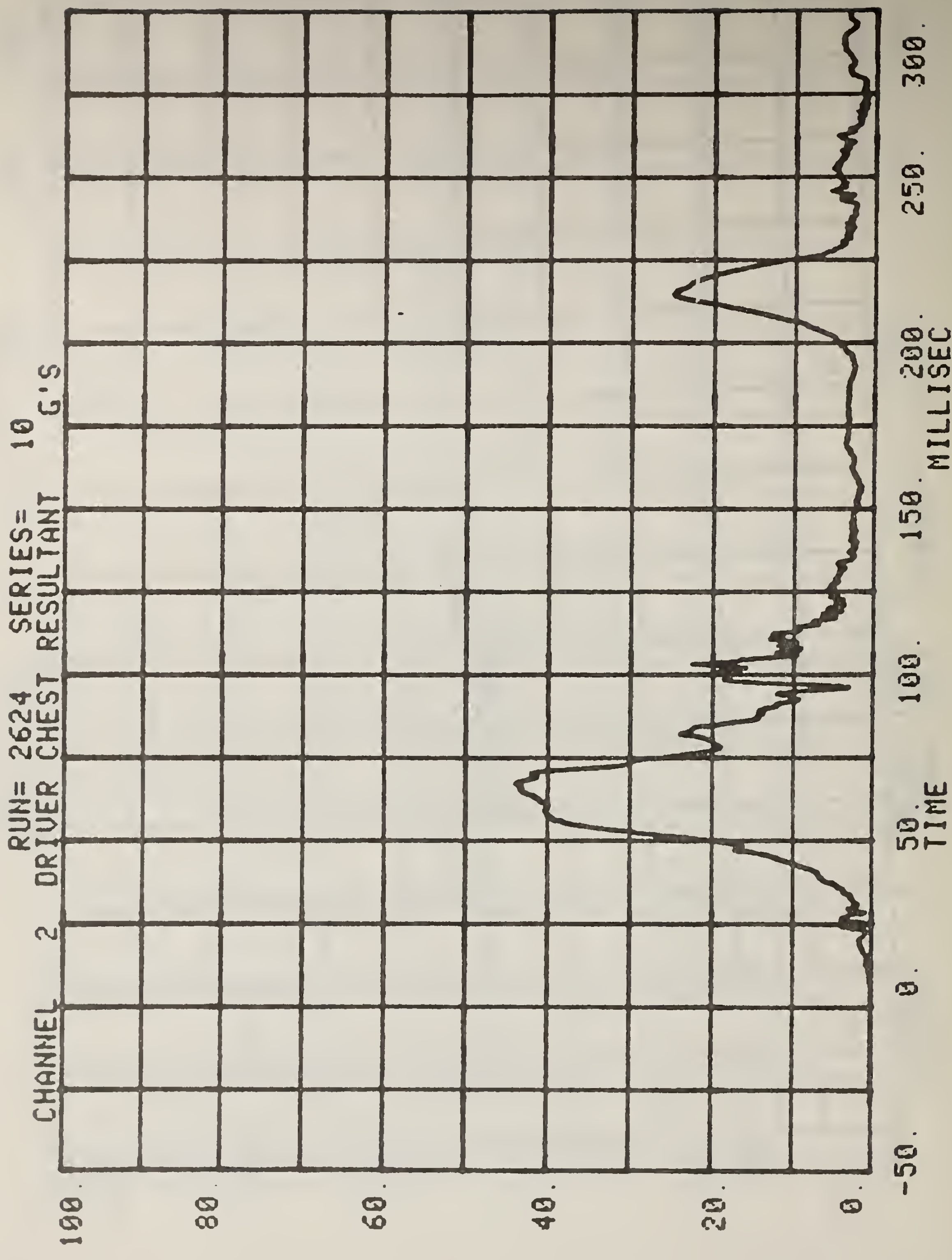

CHANNEL 1 RUN= 2624 SERIES= 10
DRIVER HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

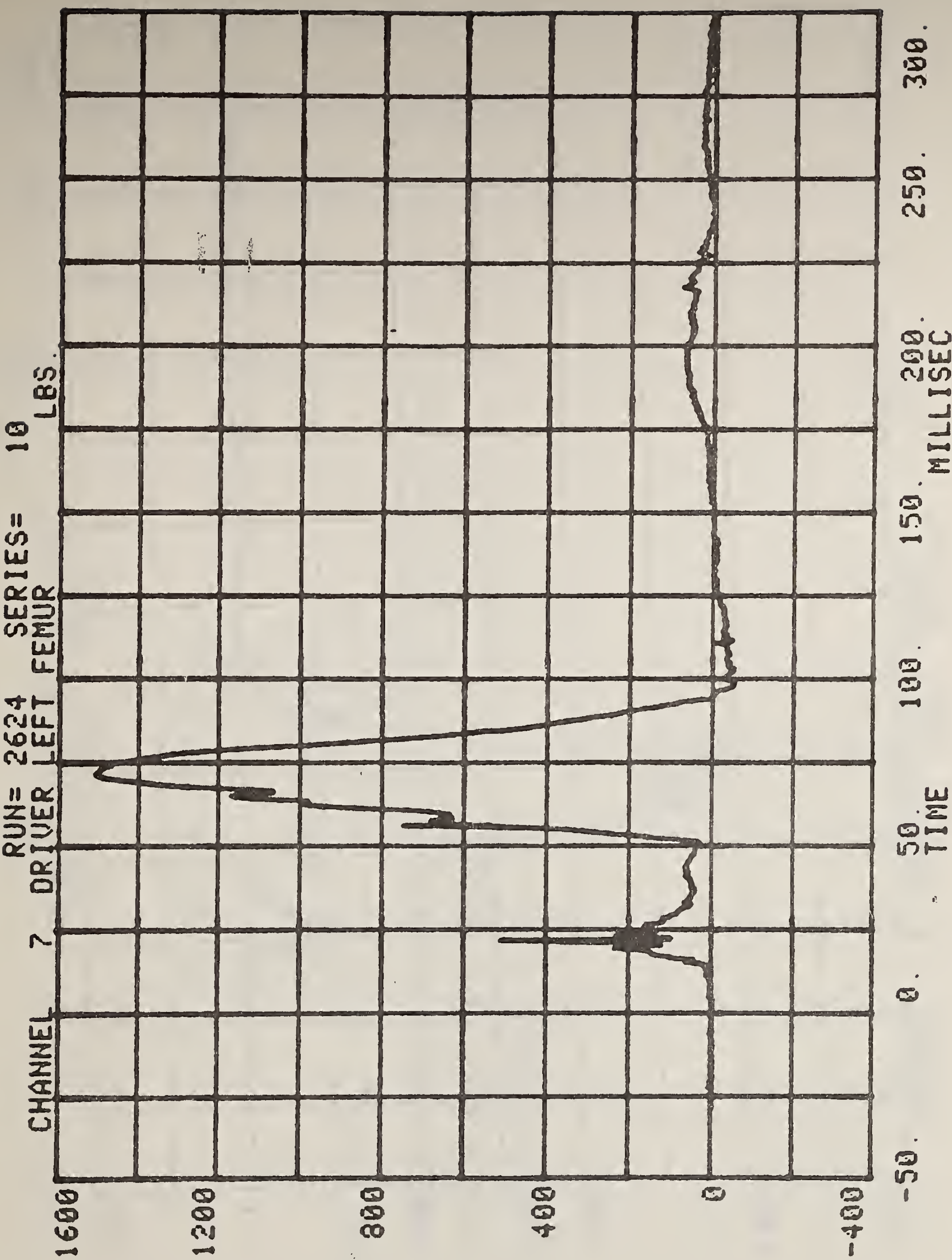

CHANNEL 4 RUN= 2624 SERIES= 10
DRIVER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

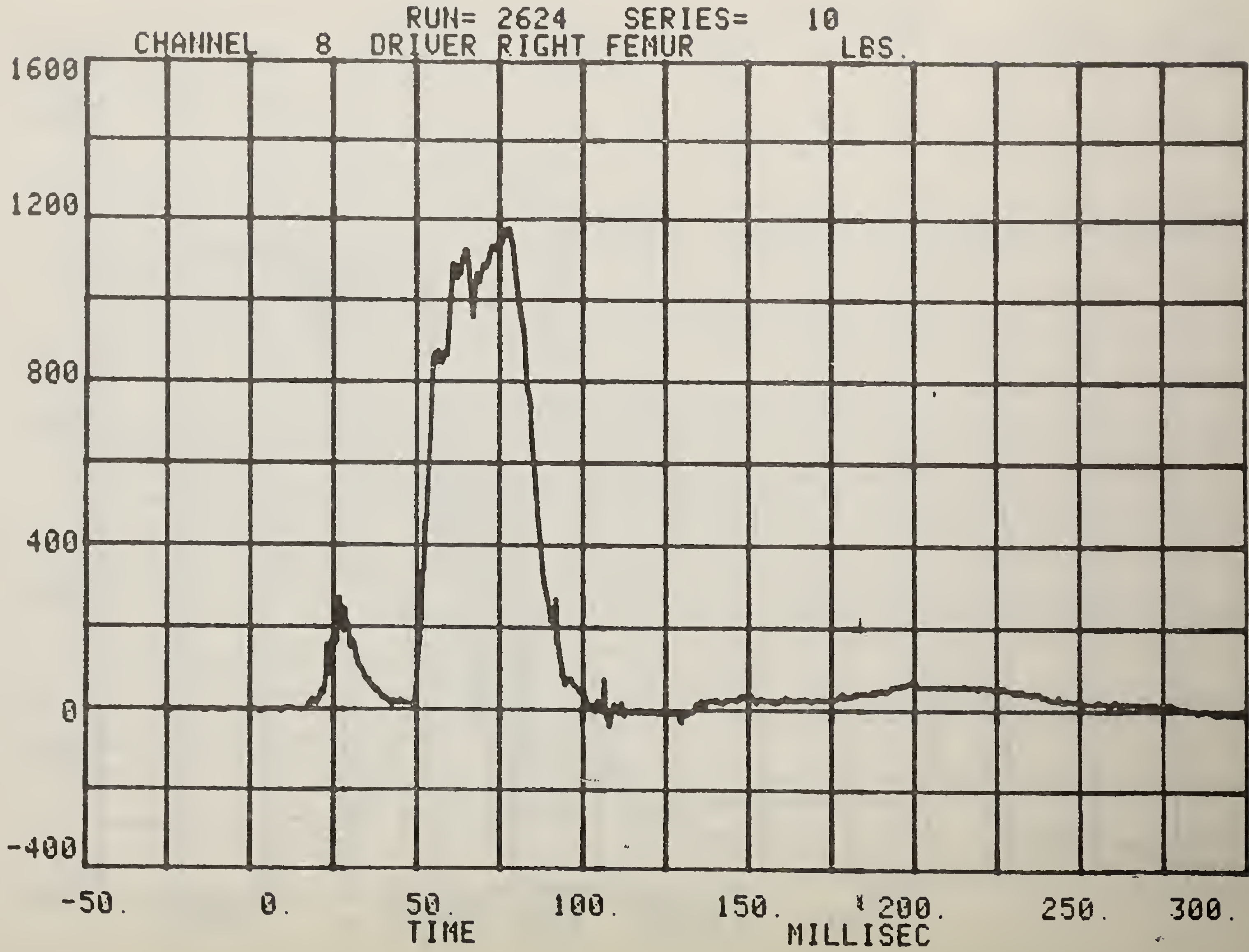


CHANNEL 5 RUN= 2624 SERIES= 10
DRIVER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2624 SERIES= 10
CHANNEL 6 DRIVER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 2 RUN= 2624 SERIES= 10
DRIVER CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 7 RUN= 2624 SERIES= 10
DRIVER LEFT FEMUR
LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2624 SERIES= 10
CHANNEL 8 DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2624

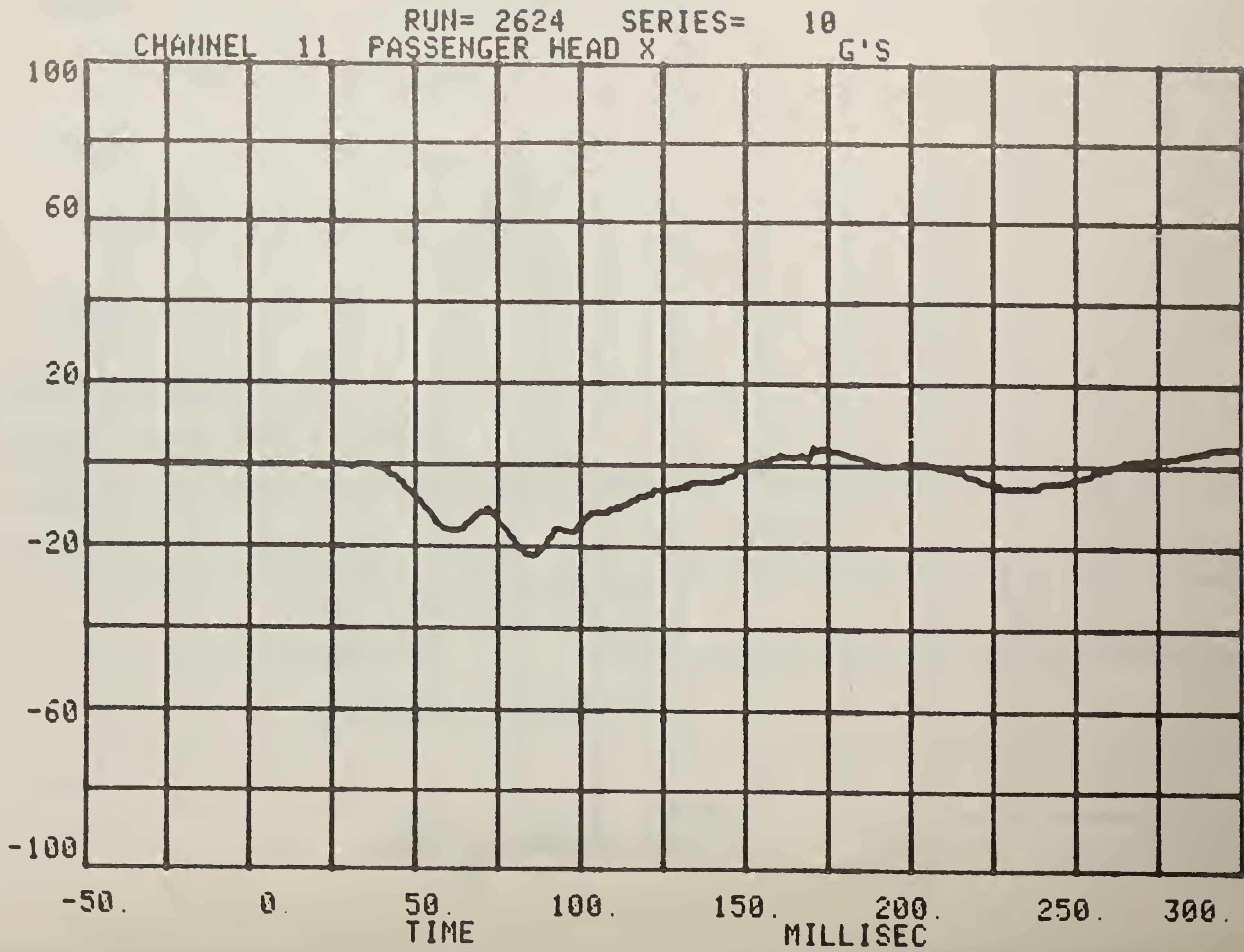
PASS. HEAD RESULTANT

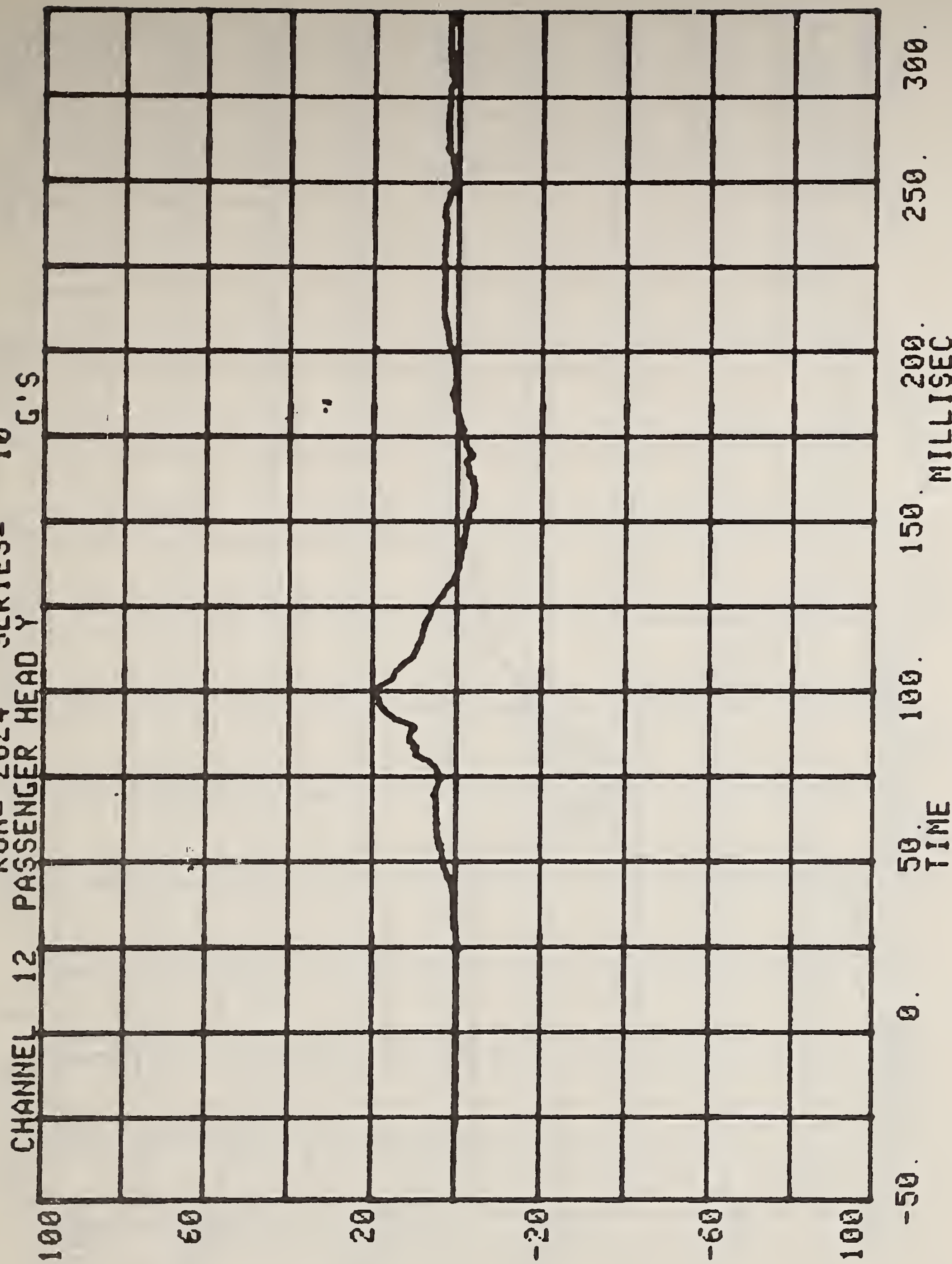
HIC= 241.6   FROM T1= .05550   TO T2= .11040

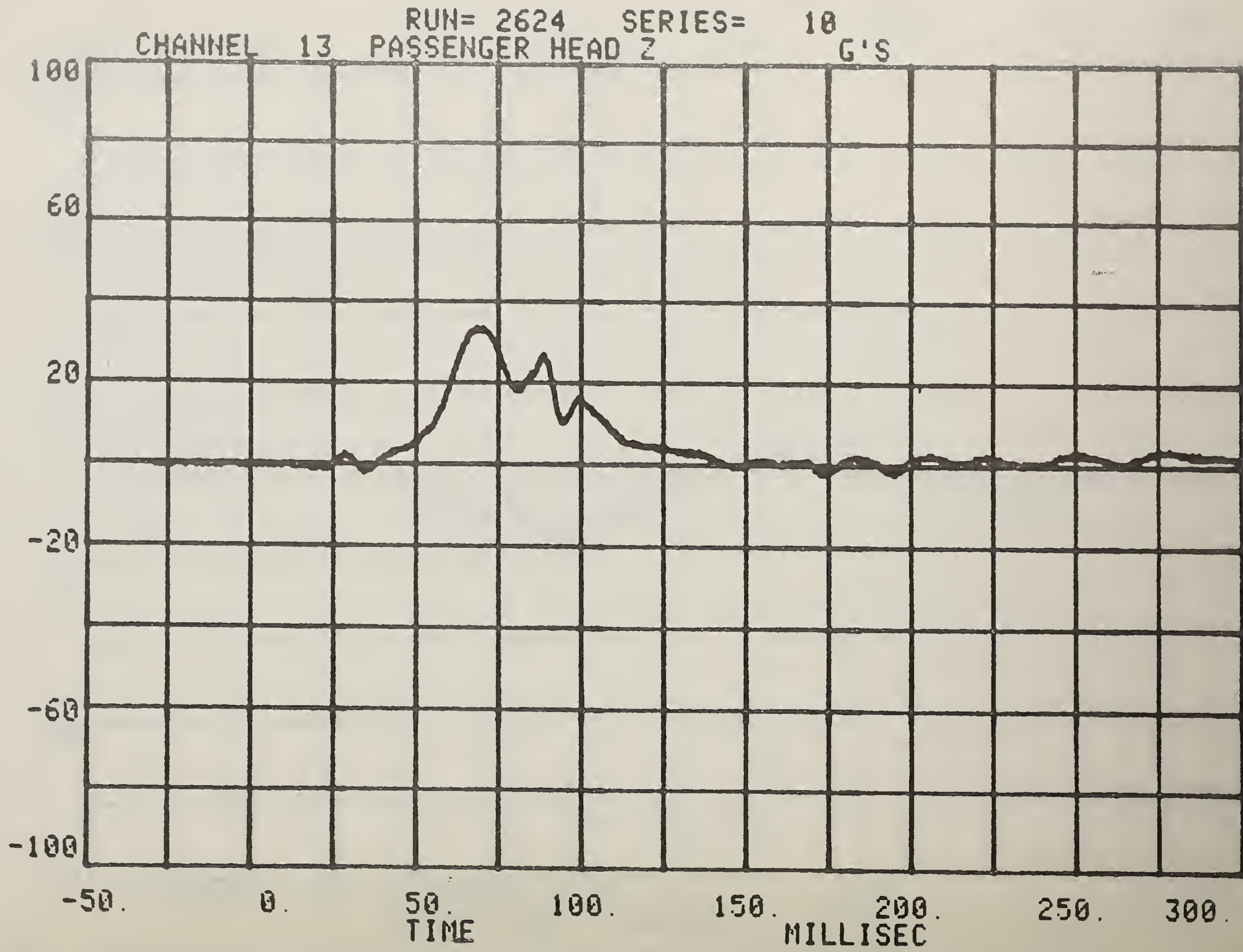
AVERAGE ACCELERATION BETWEEN T1 AND T2= 28.7G'S

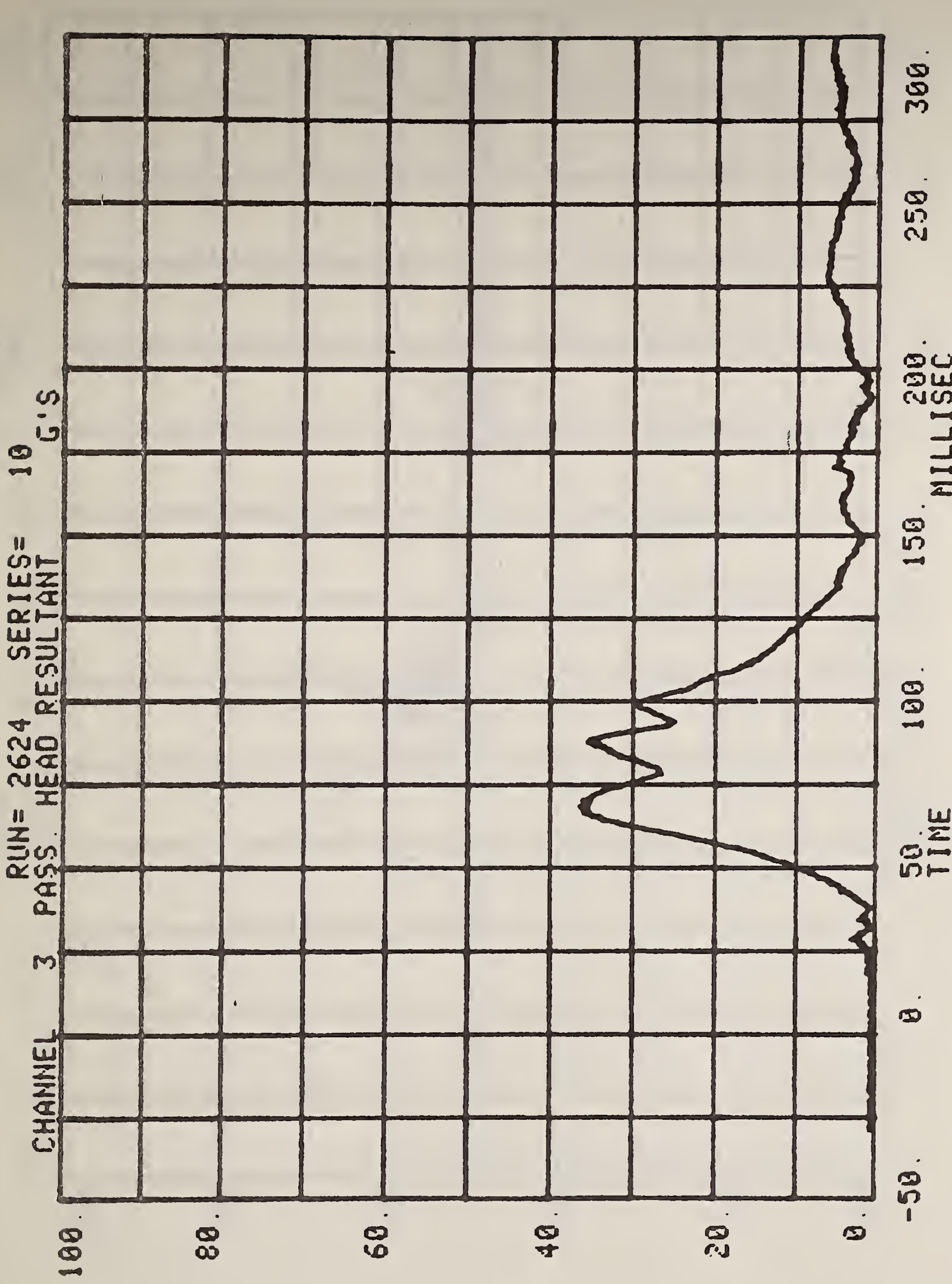
EVENT TIME= 300.0 MSEC

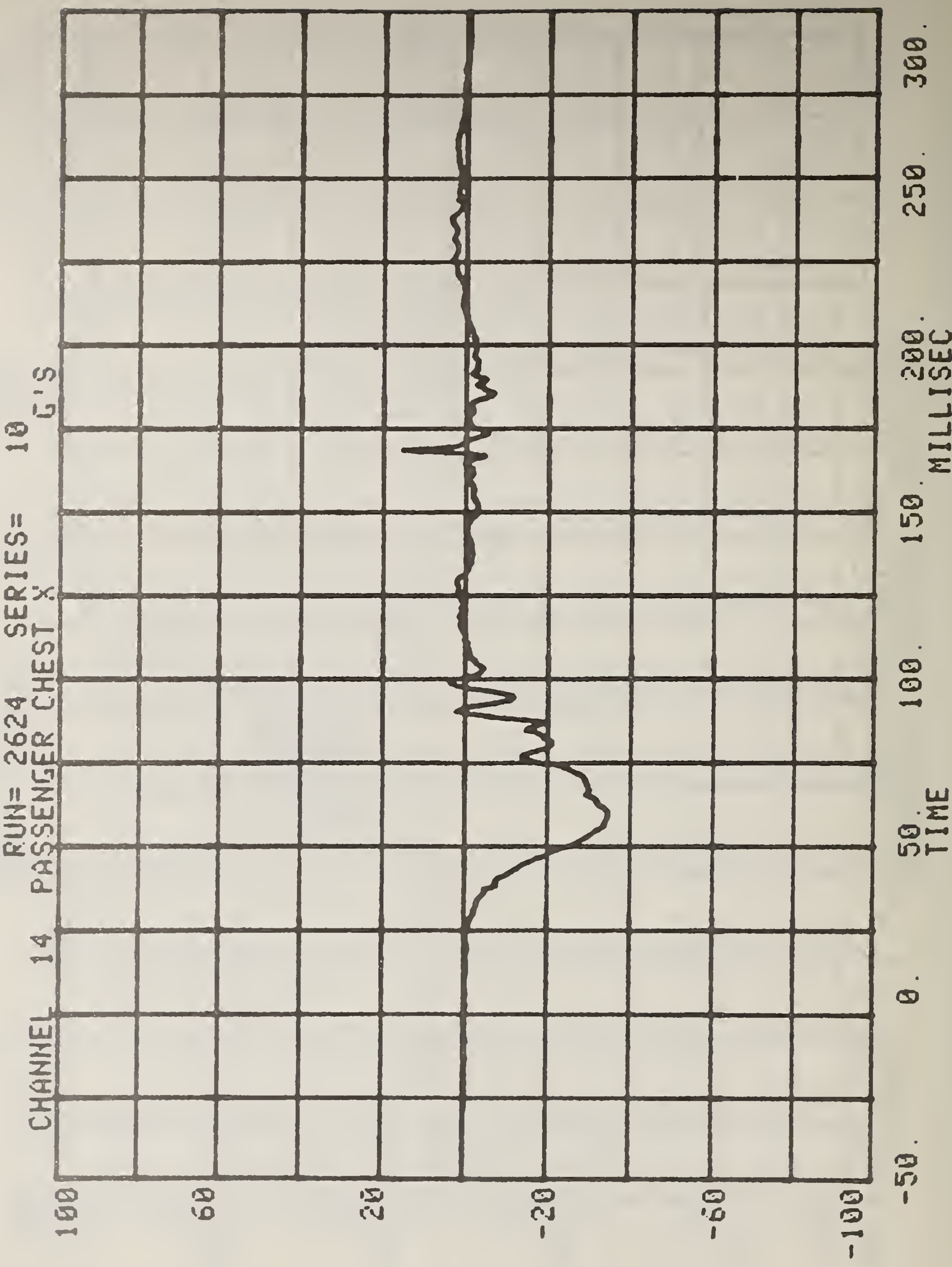
SEVERITY INDEX= 276.8

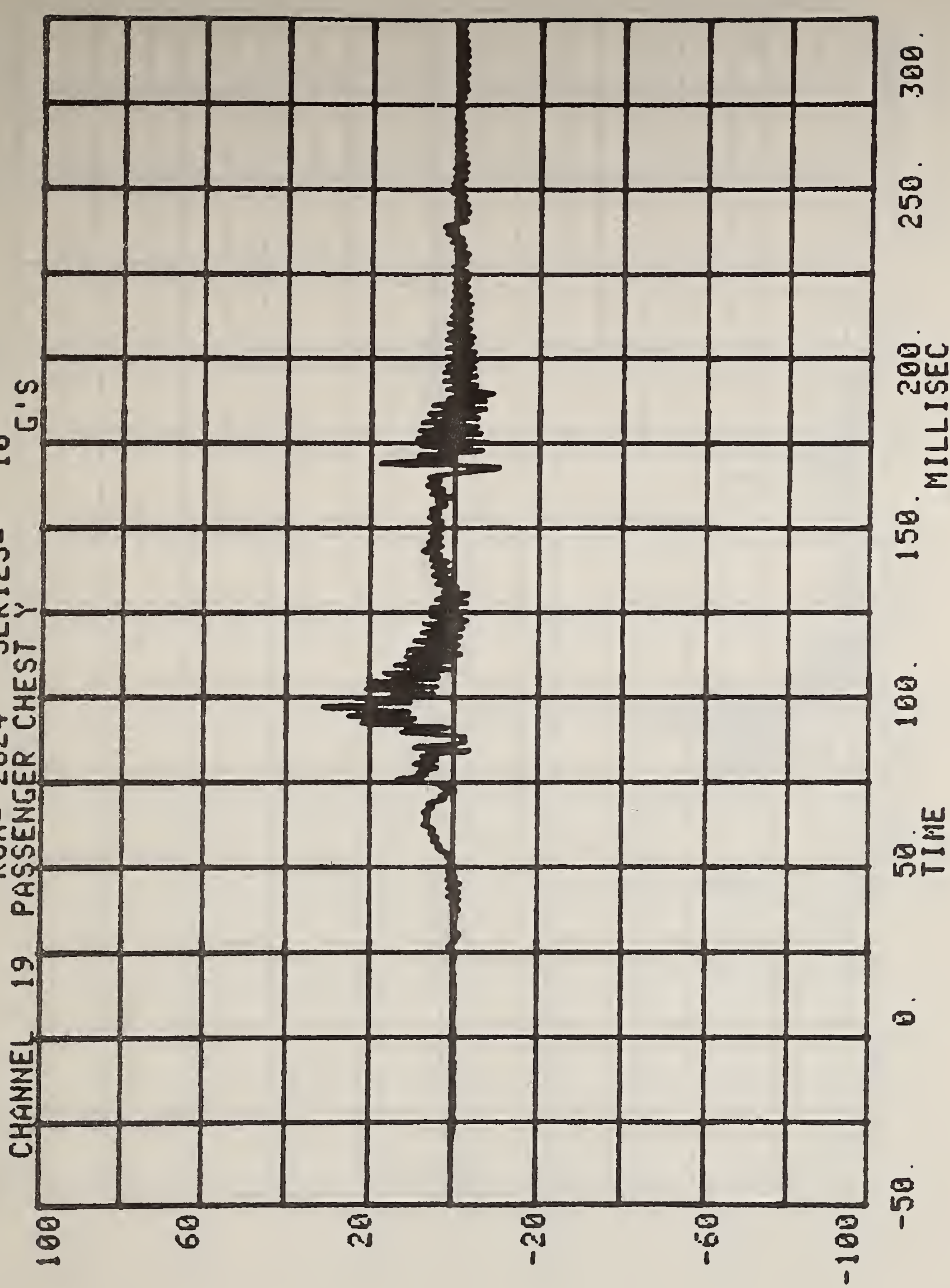

RUN= 2624 SERIES= 10
CHANNEL 11 PASSENGER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

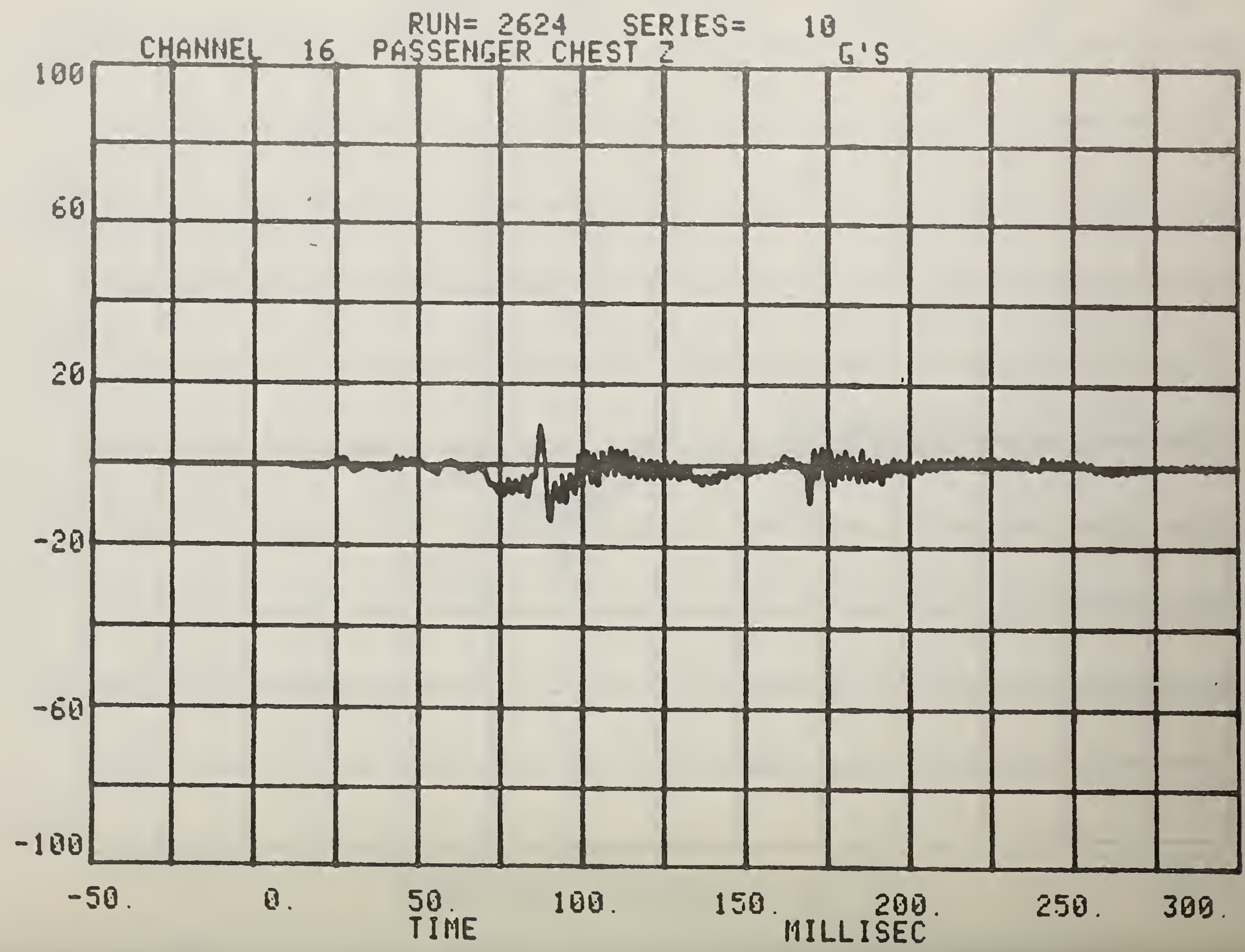

CHANNEL 12 RUN= 2624 SERIES= 10
PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

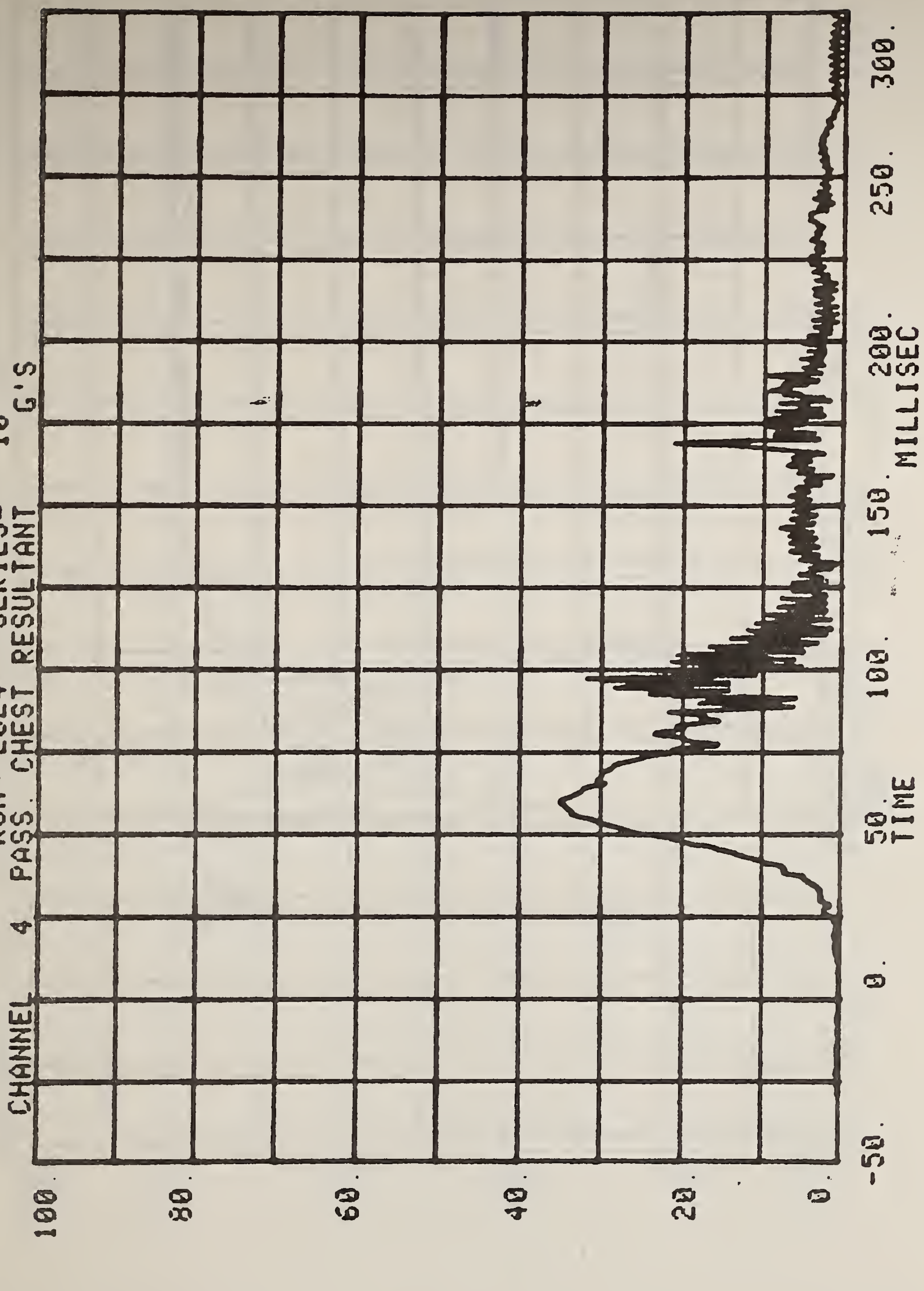

RUN= 2624 SERIES= 10
CHANNEL 13 PASSENGER HEAD Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

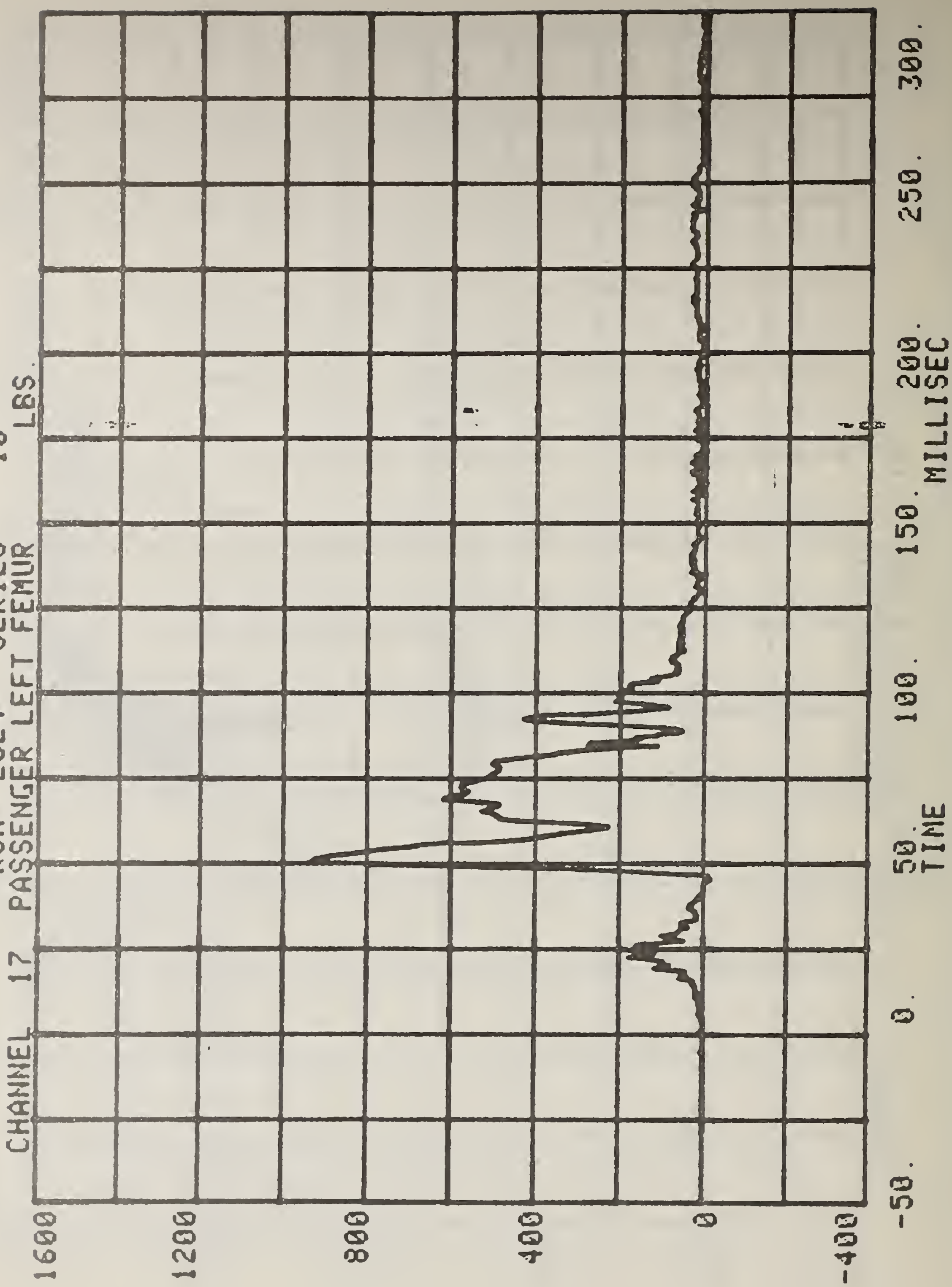

CHANNEL 3 RUN= 2624 SERIES= 10
PASS. HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 14 RUN= 2624 SERIES= 10
PASSENGER CHEST X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

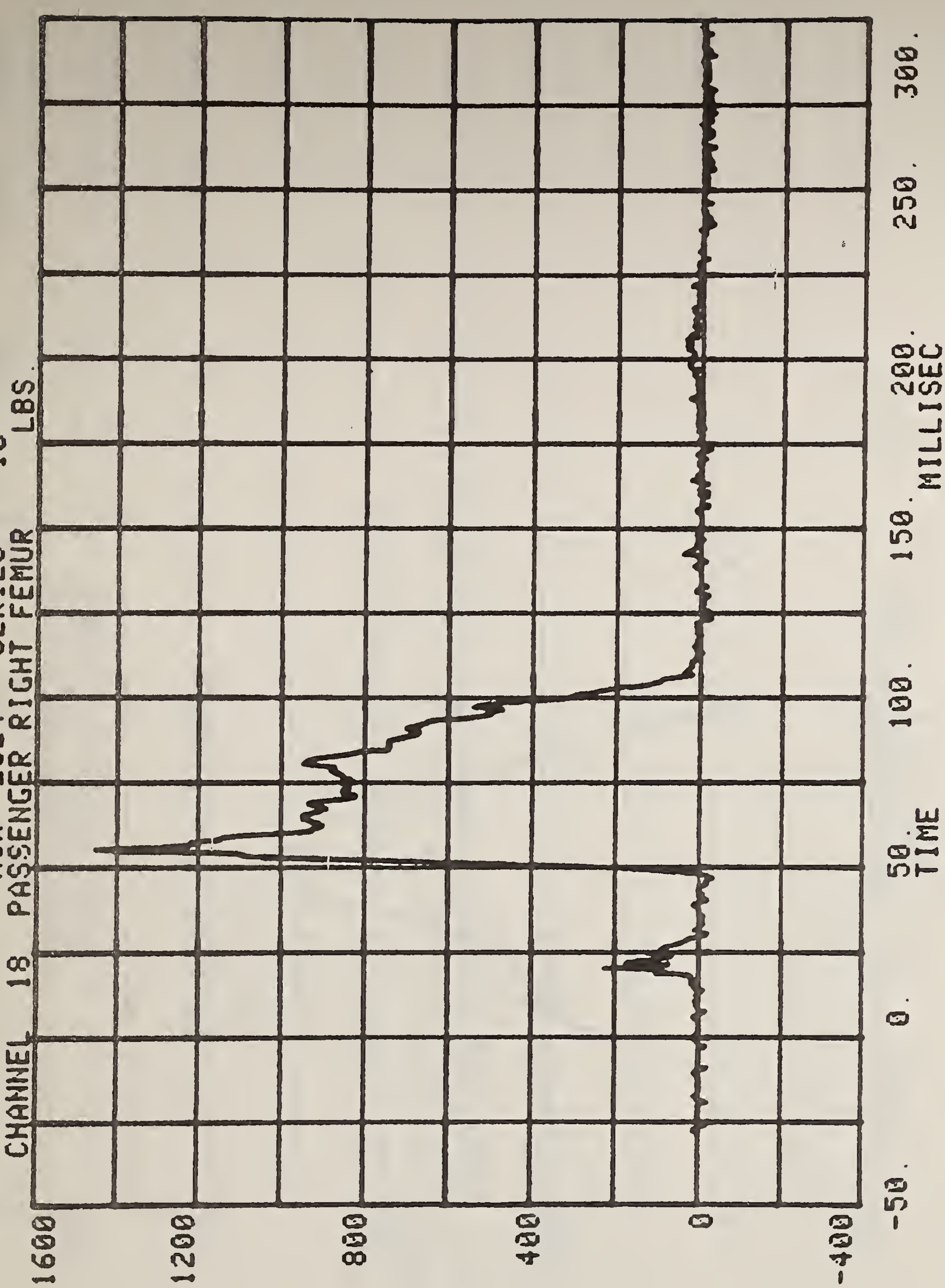

CHANNEL 19 RUN= 2624 SERIES= 10
PASSENGER CHEST Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

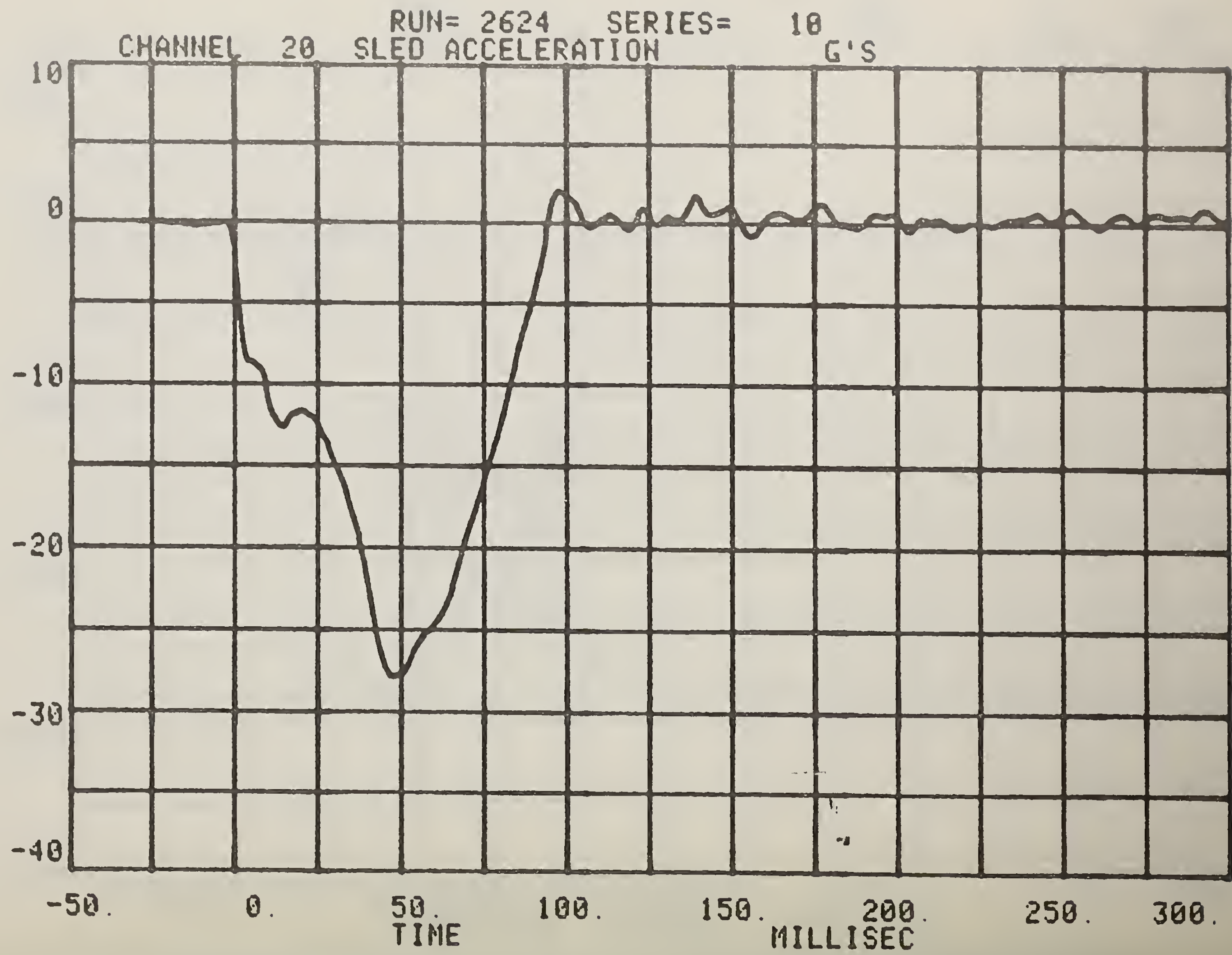

RUN= 2624 SERIES= 10
CHANNEL 16 PASSENGER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 4 RUN= 2624 SERIES= 10
PASS. CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



CHANNEL 17 RUN= 2624 SERIES= 10
PASSENGER LEFT FEMUR LBS
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 18 RUN= 2624 SERIES= 10
PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2624 SERIES= 10
CHANNEL 20 SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2625

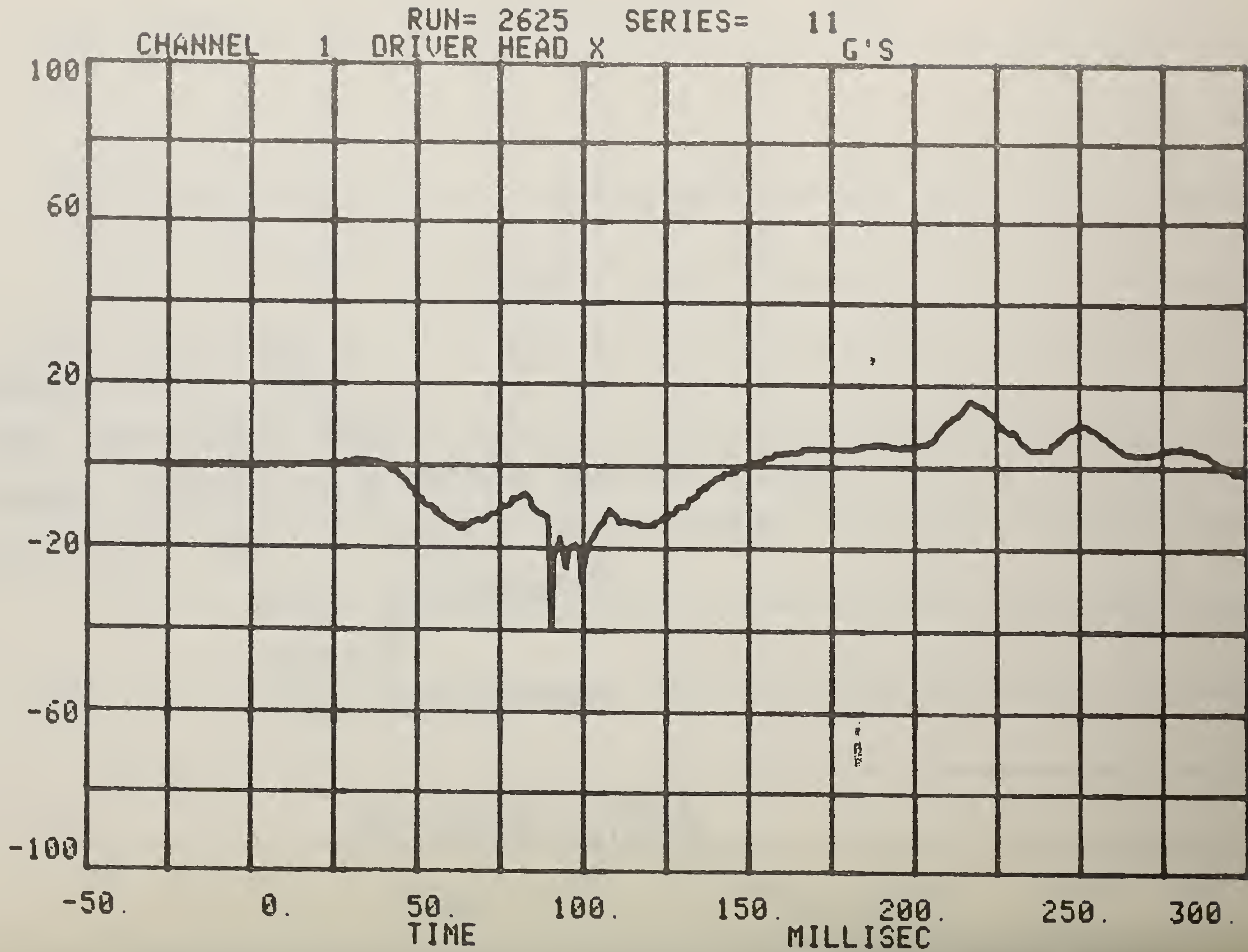
DRIVER HEAD RESULTANT

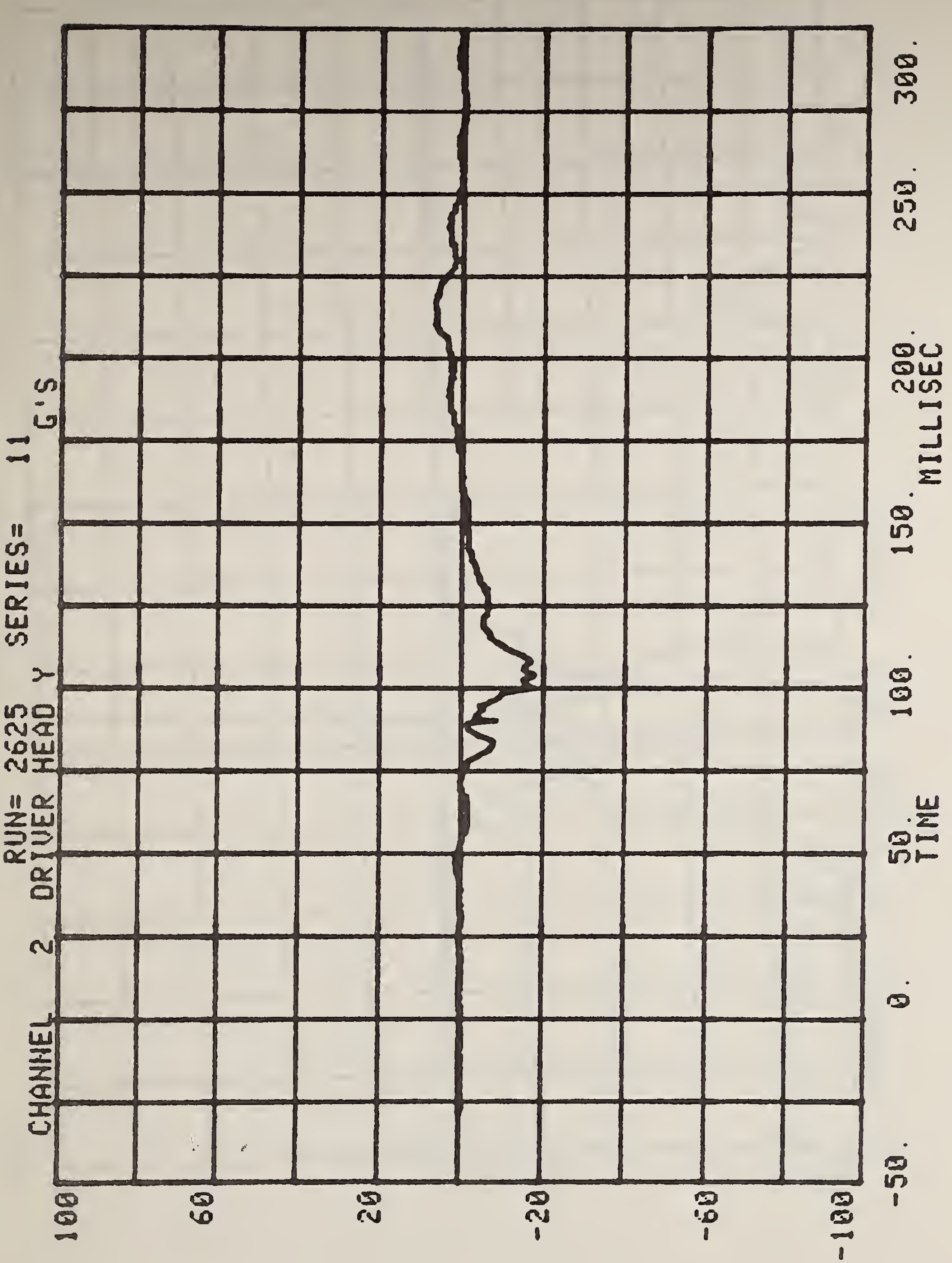
HIC= 353.6   FROM T1= .05970   TO T2= .11130

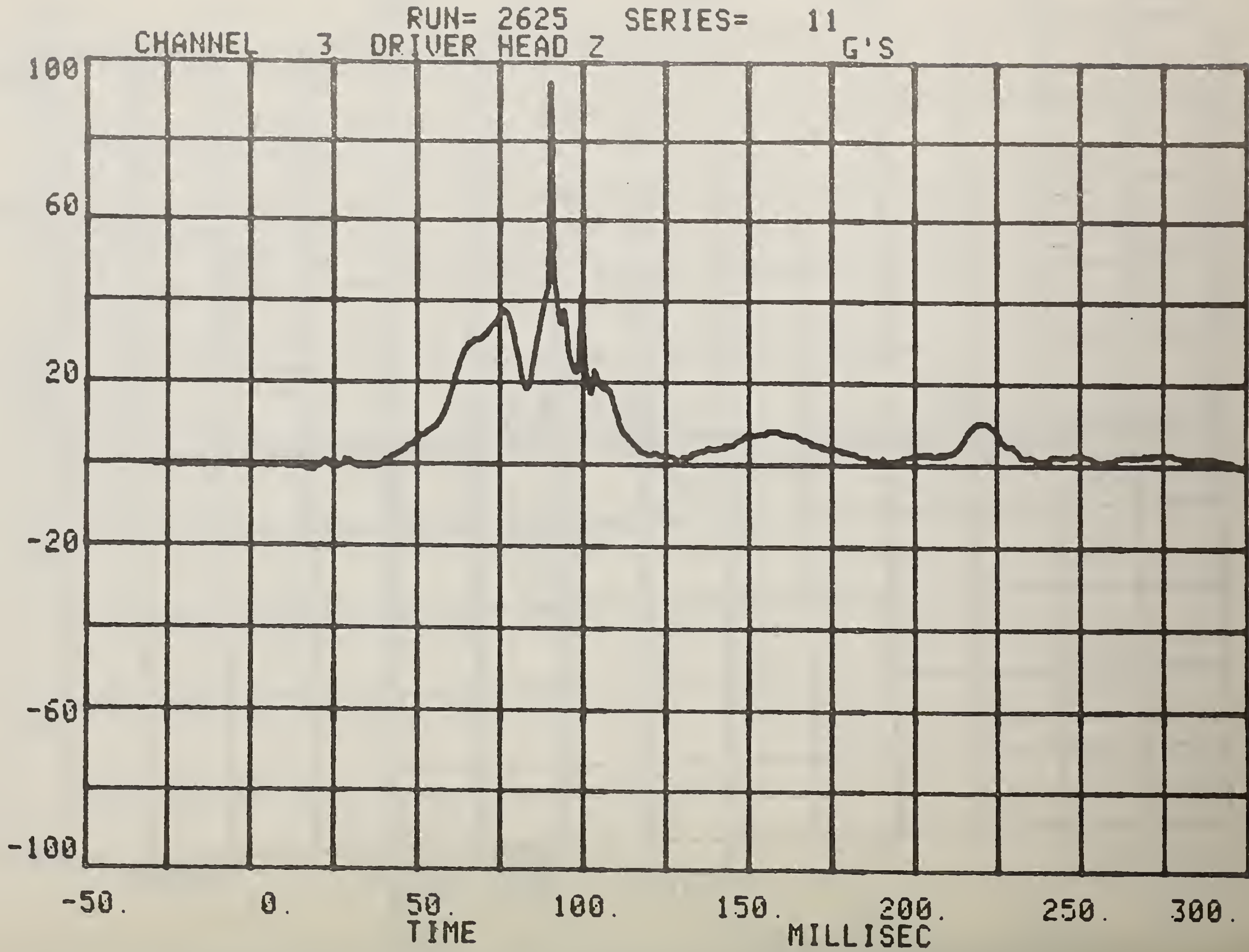
AVERAGE ACCELERATION BETWEEN T1 AND T2= 34.2G'S

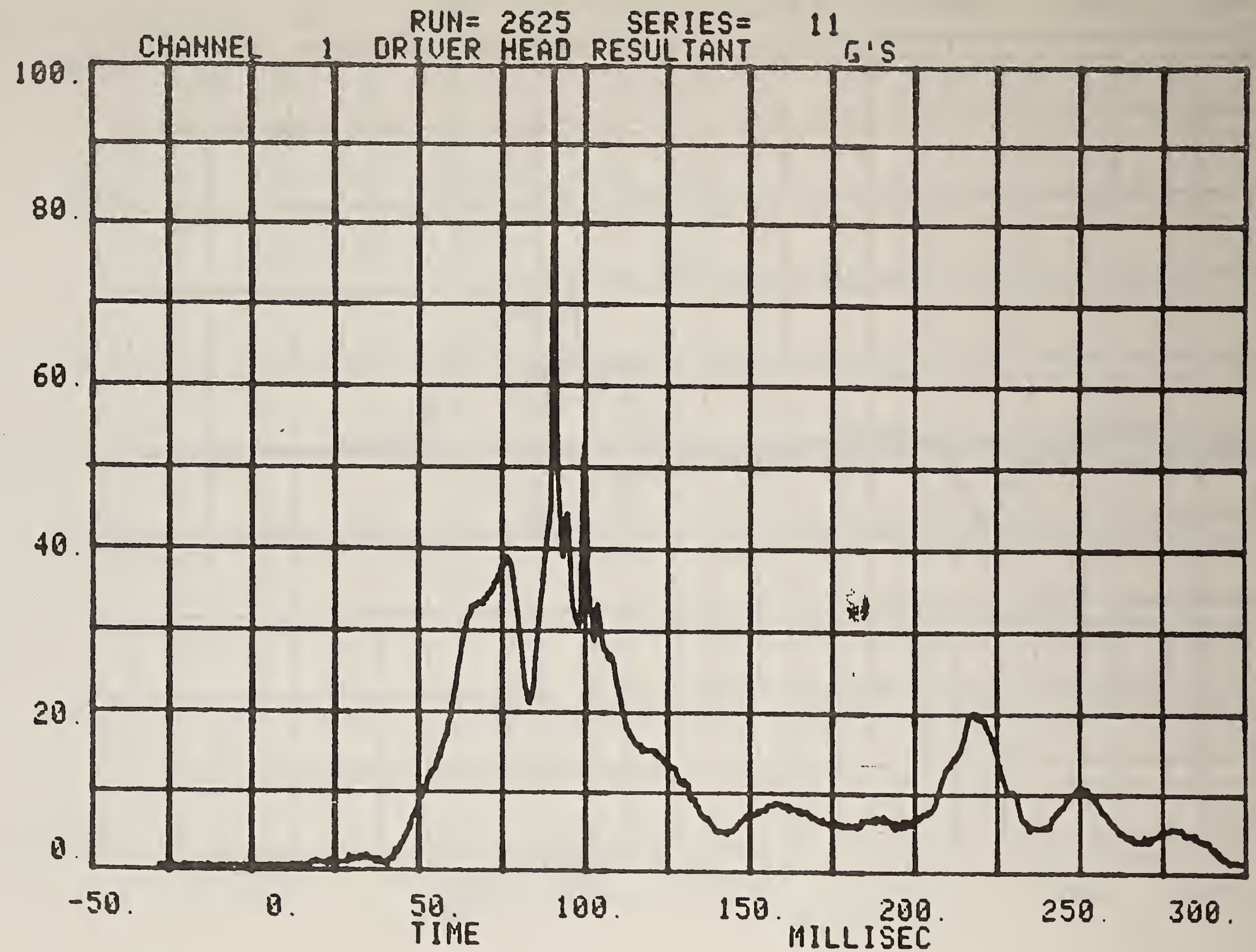
EVENT TIME= 300.0 MSEC

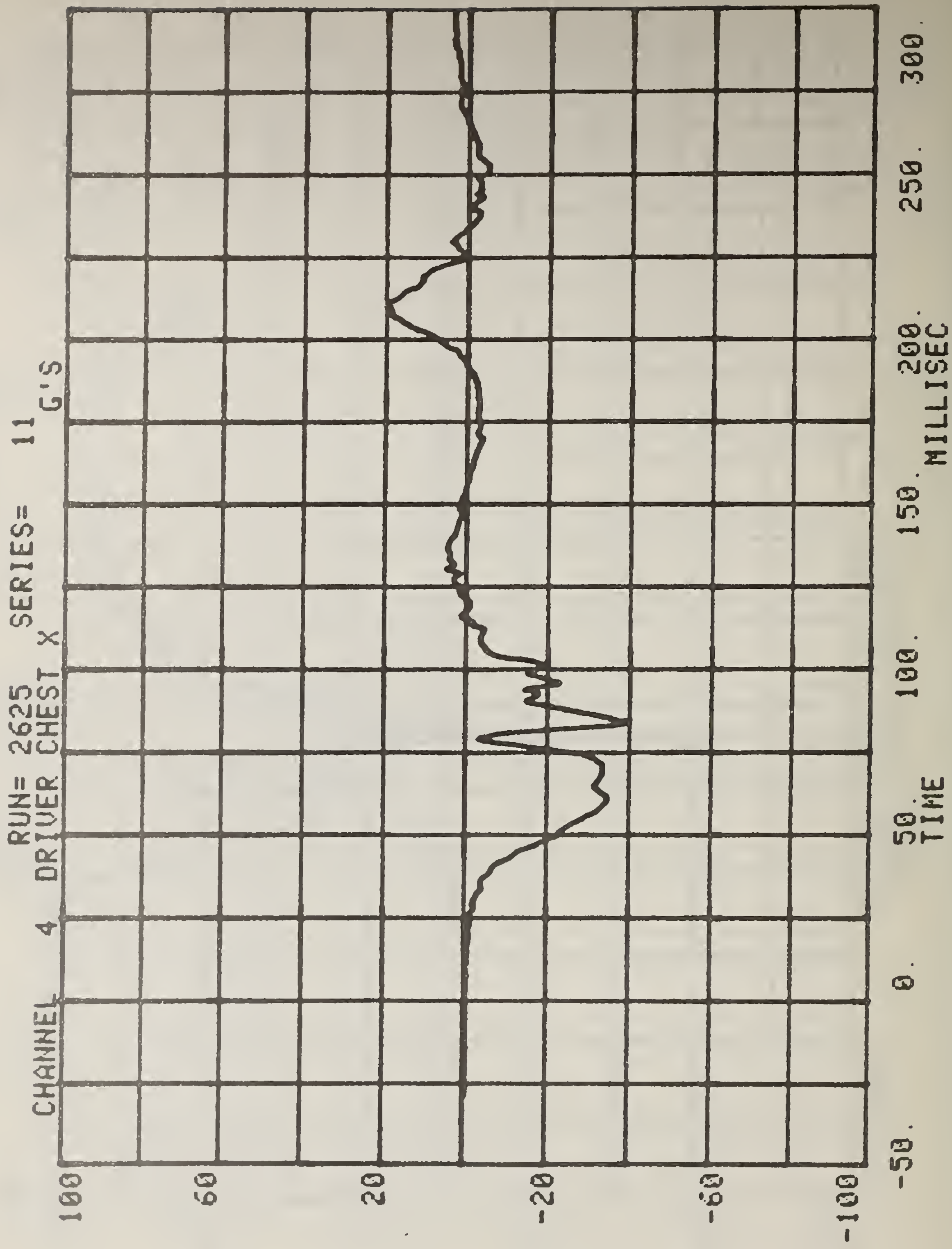
SEVERITY INDEX= 492.8

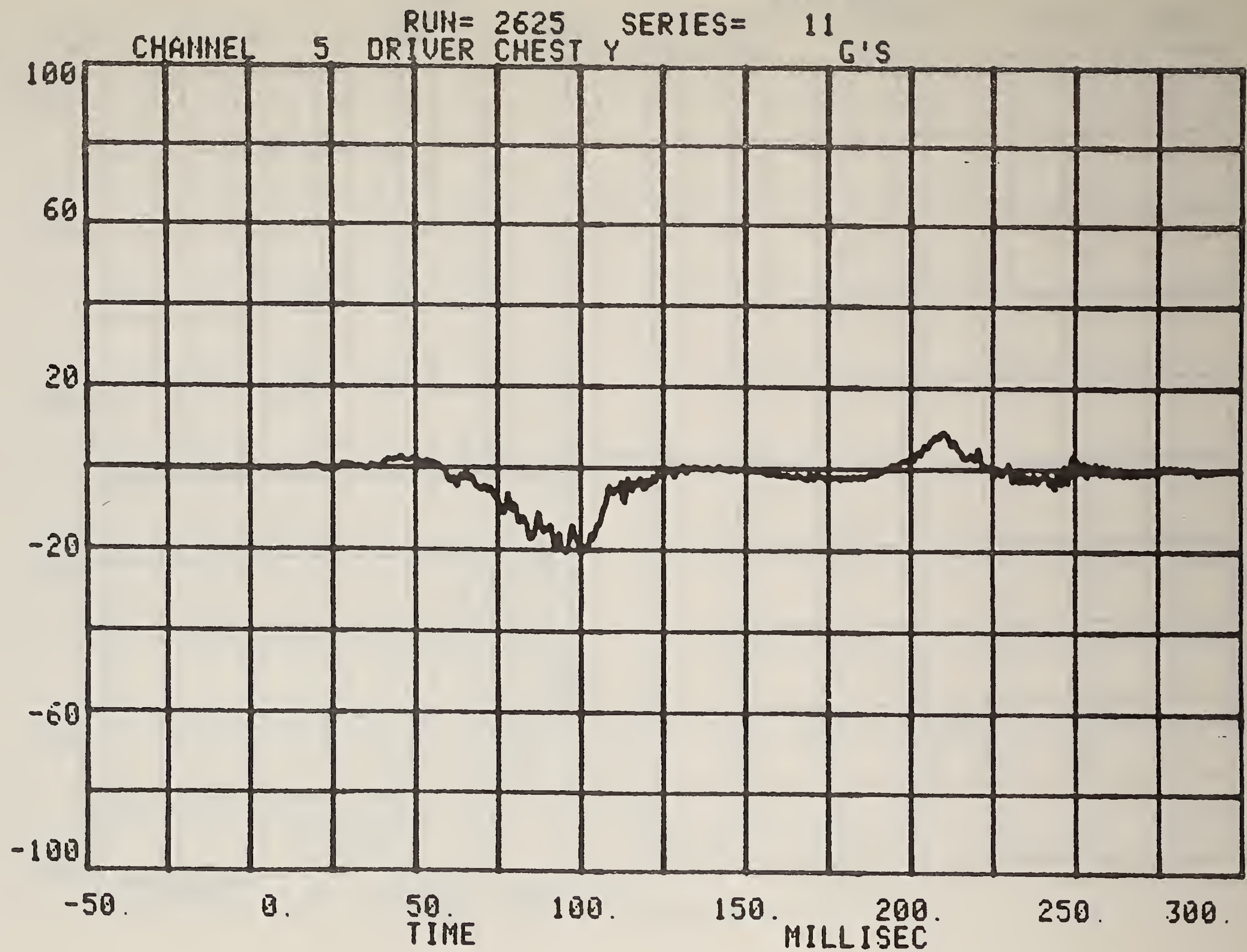

RUN= 2625 SERIES= 11
CHANNEL 1 DRIVER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

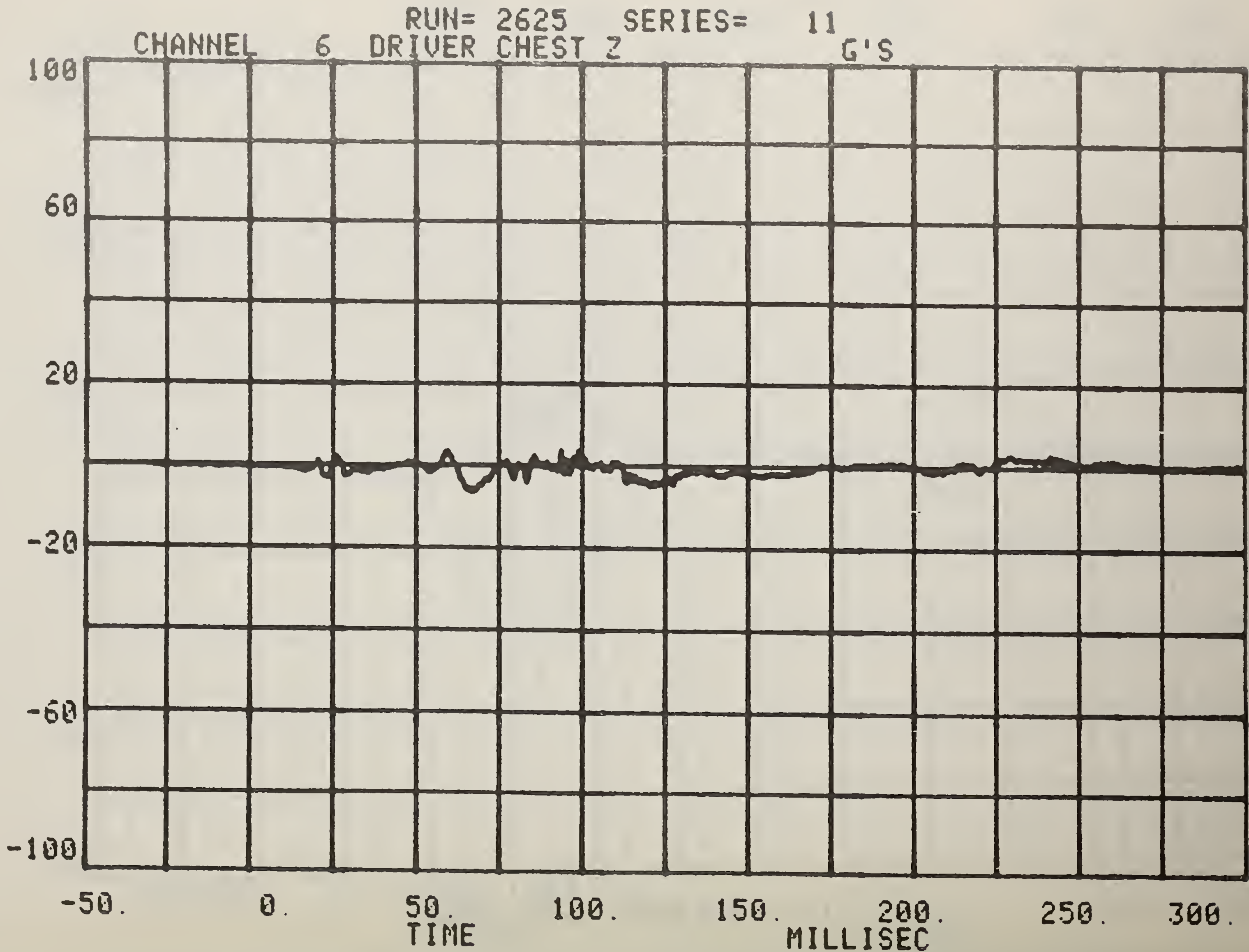

CHANNEL 2 RUN= 2625 SERIES= 11
DRIVER HEAD Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2625 SERIES= 11
CHANNEL 3 DRIVER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

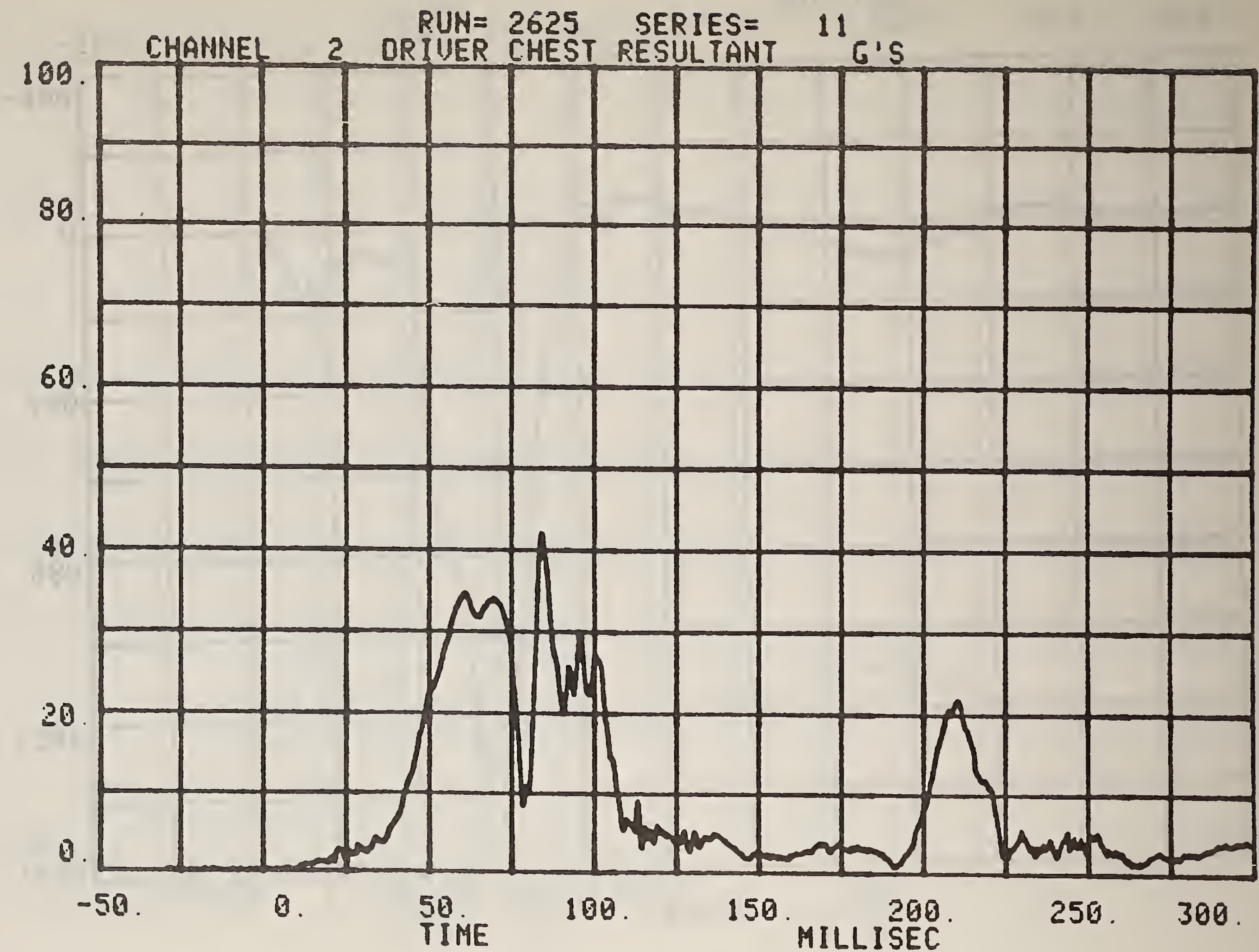

RUN= 2625 SERIES= 11
CHANNEL 1 DRIVER HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 4 RUN= 2625 SERIES= 11
DRIVER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

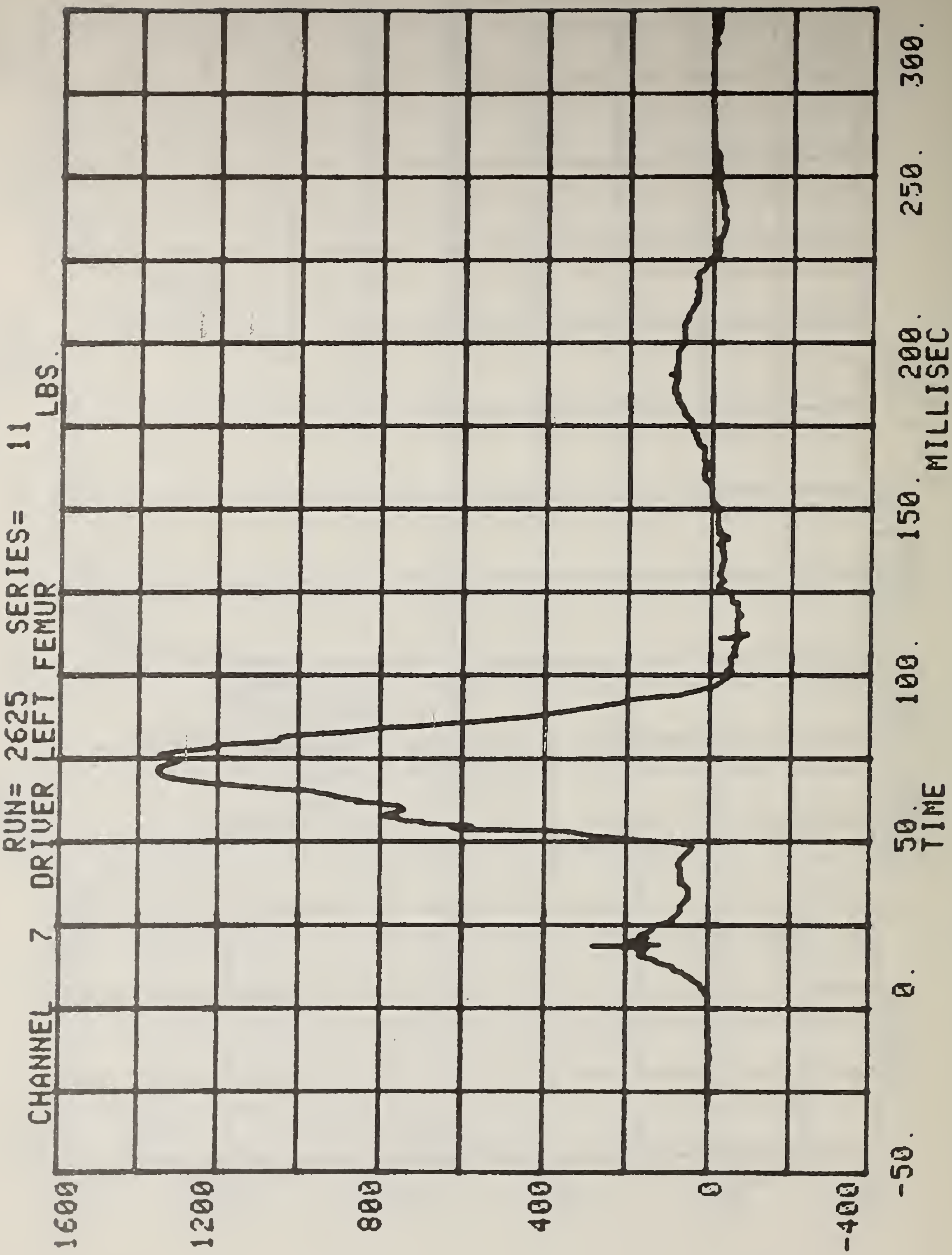

RUN= 2625 SERIES= 11
CHANNEL 5 DRIVER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

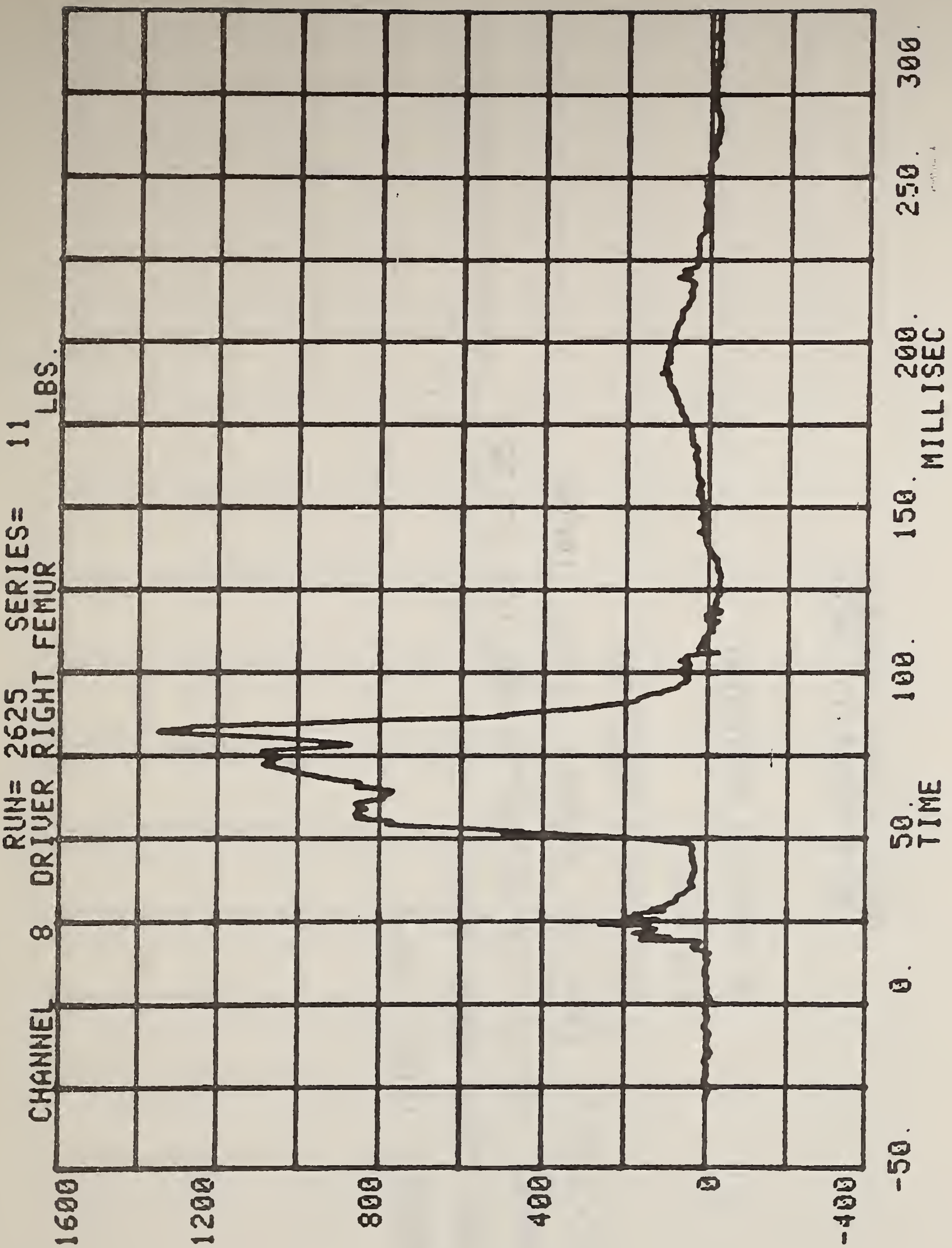


RUN= 2625 SERIES= 11
CHANNEL 6 DRIVER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC



RUN= 2625 SERIES= 11
CHANNEL 2 DRIVER CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 7 RUN= 2625 SERIES= 11
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 8 RUN= 2625 SERIES= 11
DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2625

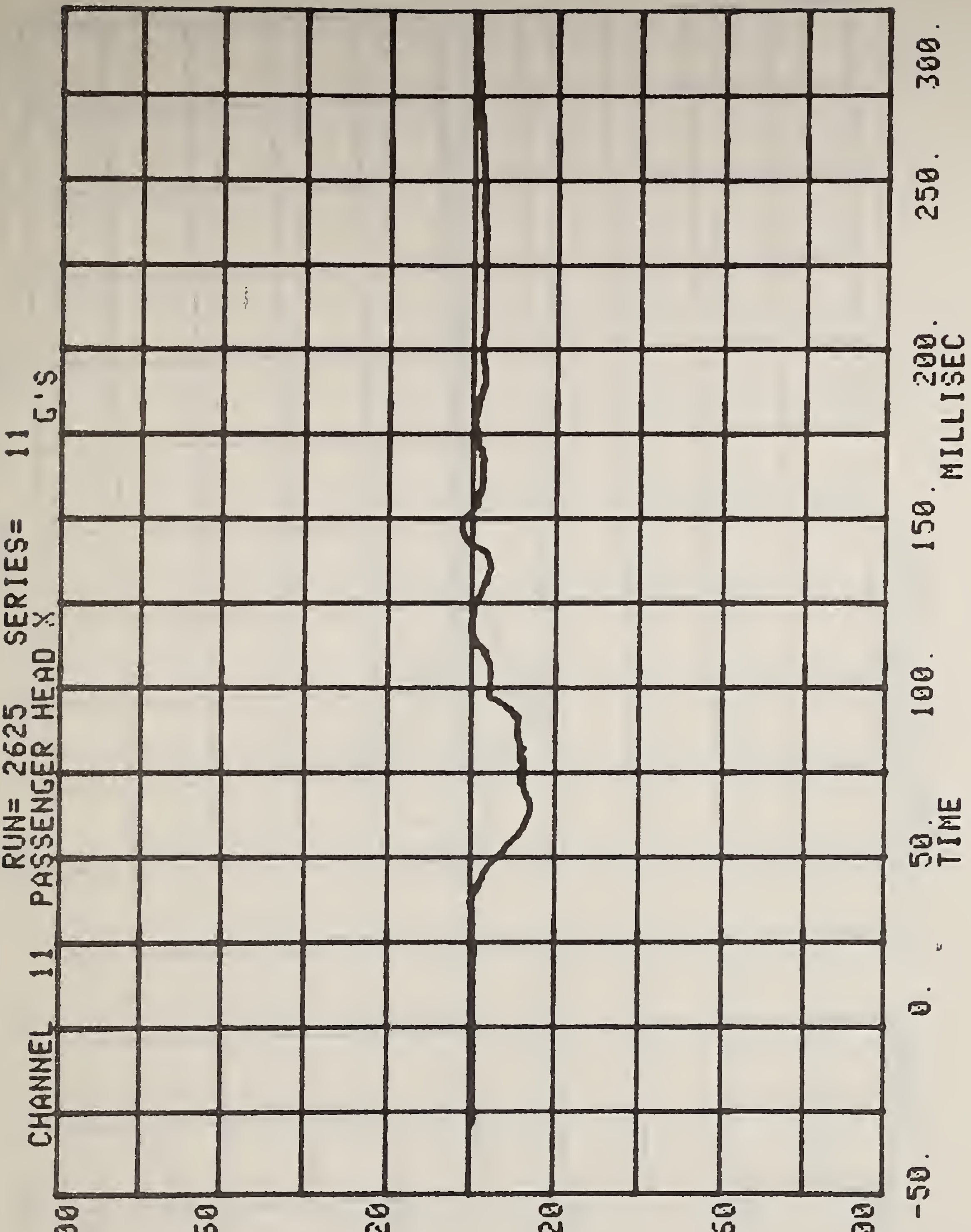
PASS. HEAD RESULTANT

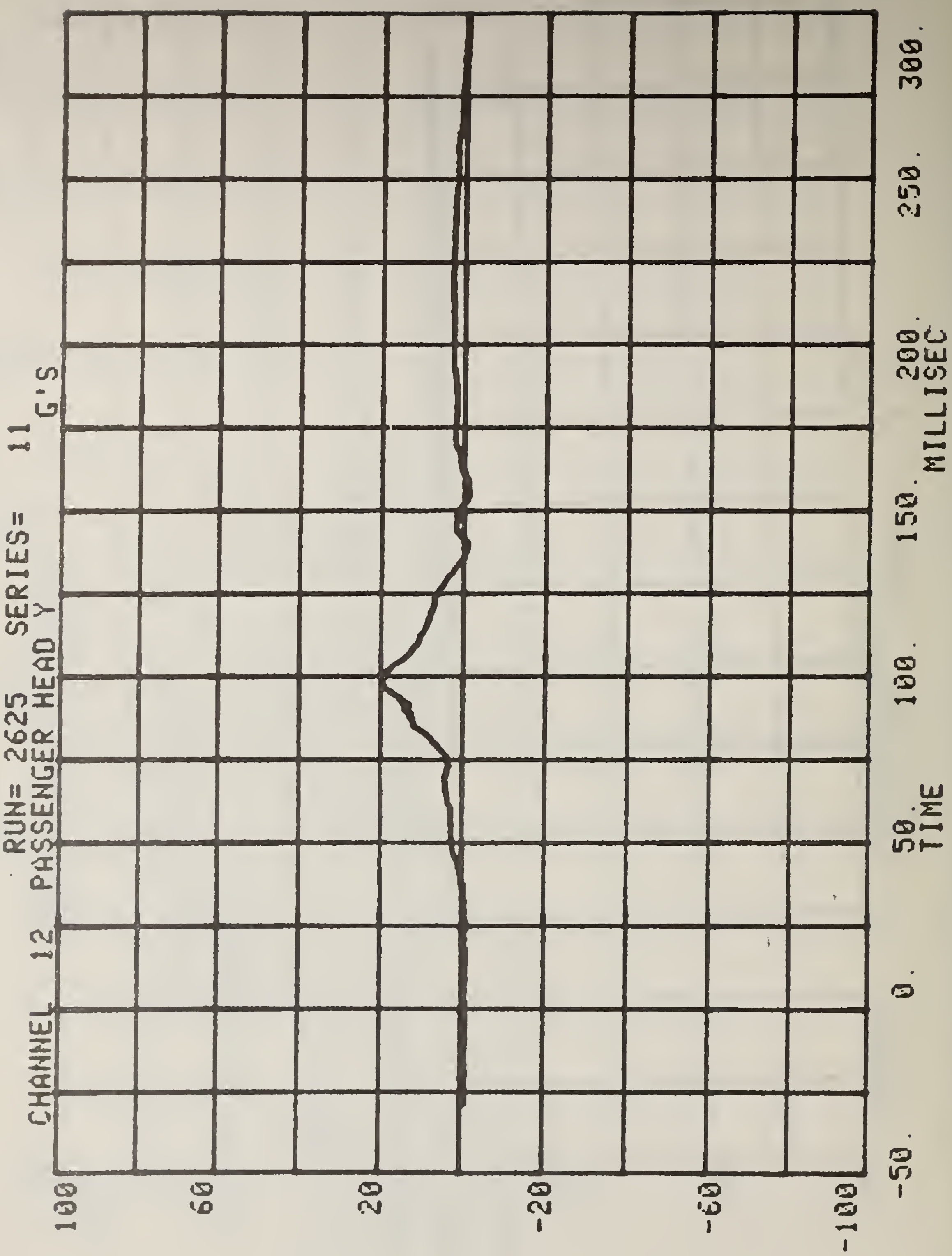
HIC= 163.7   FROM T1= .05820   TO T2= .10890

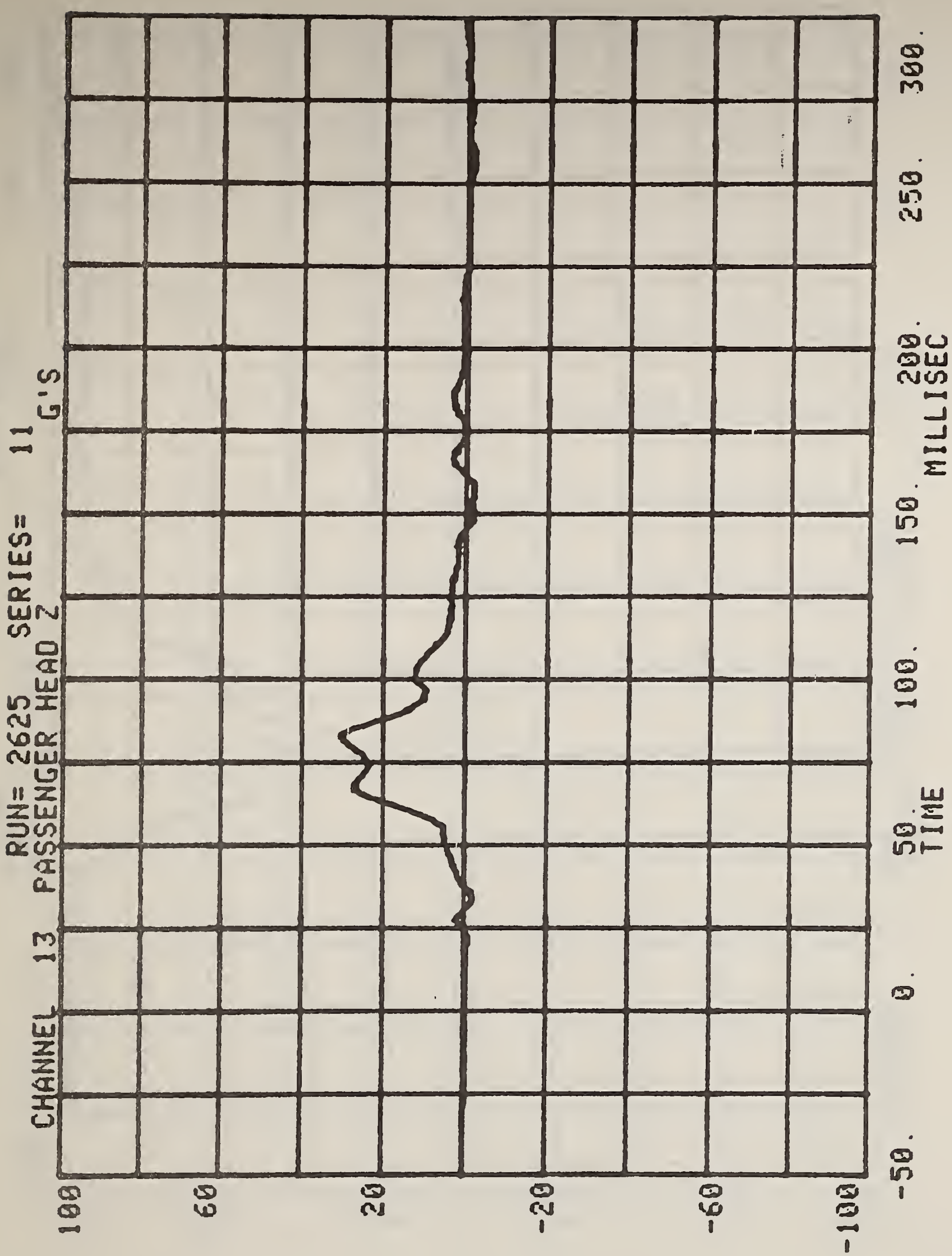
AVERAGE ACCELERATION BETWEEN T1 AND T2= 25.3G'S

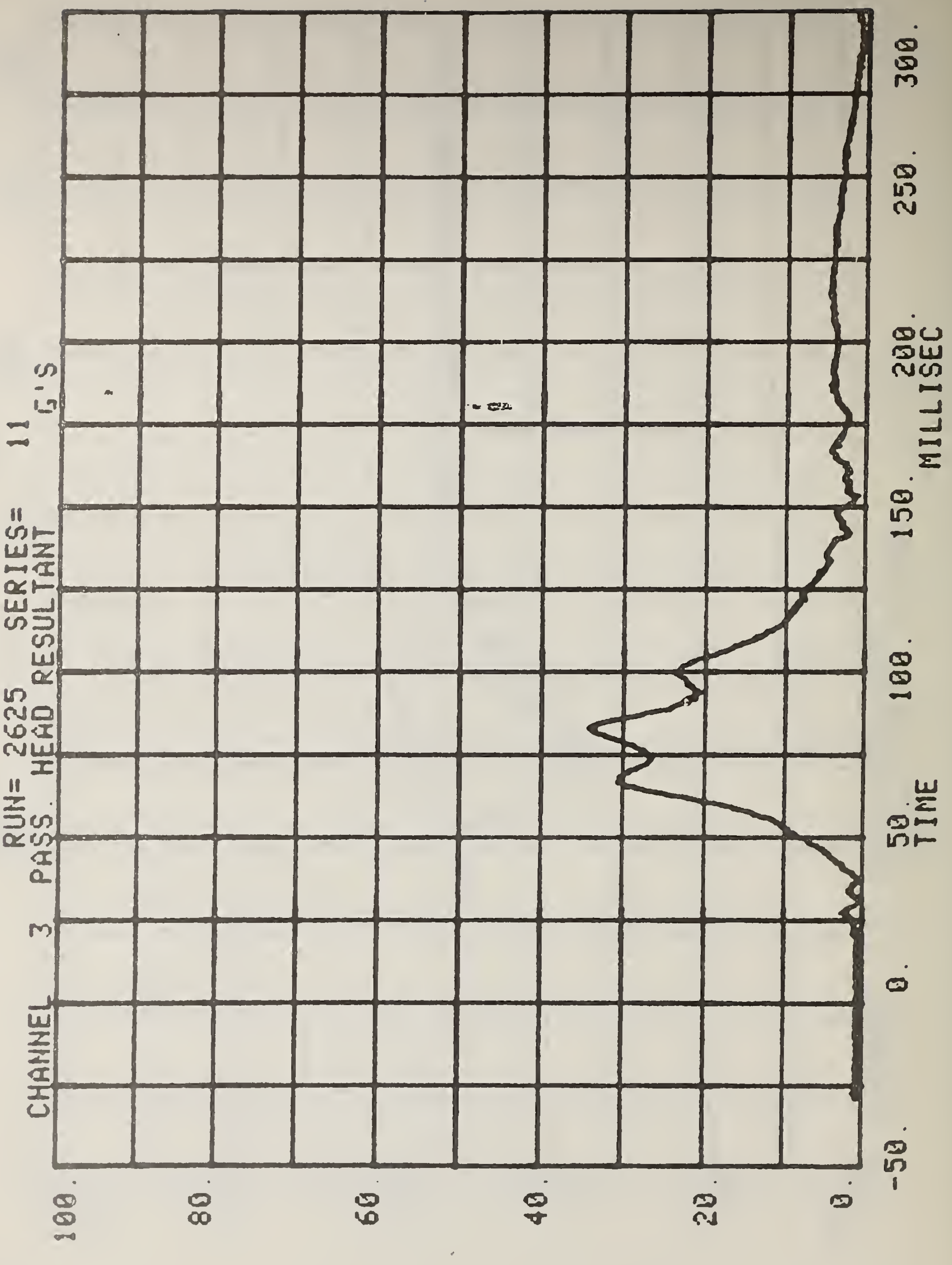
EVENT TIME= 300.0 MSEC

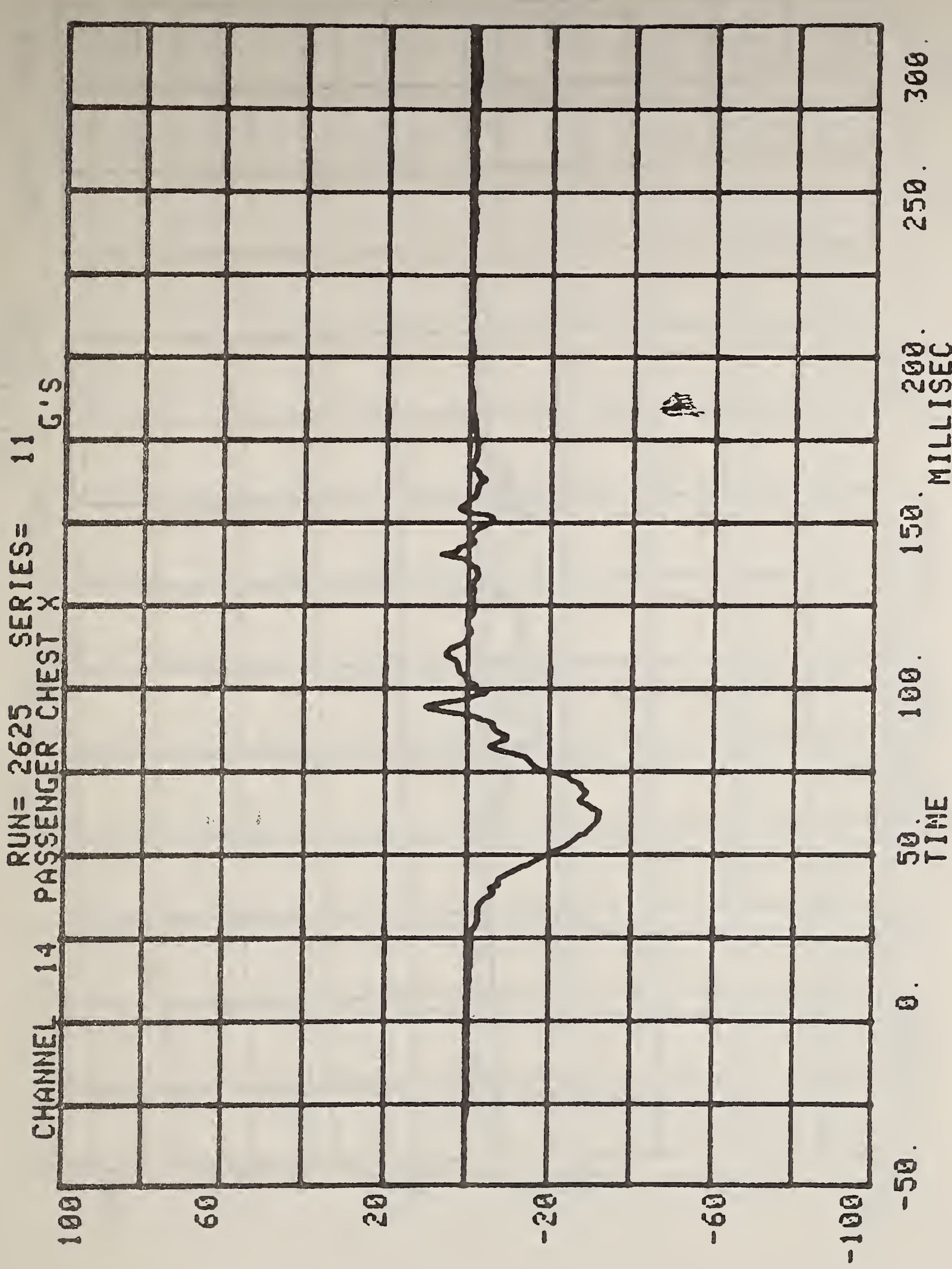
SEVERITY INDEX= 189.6

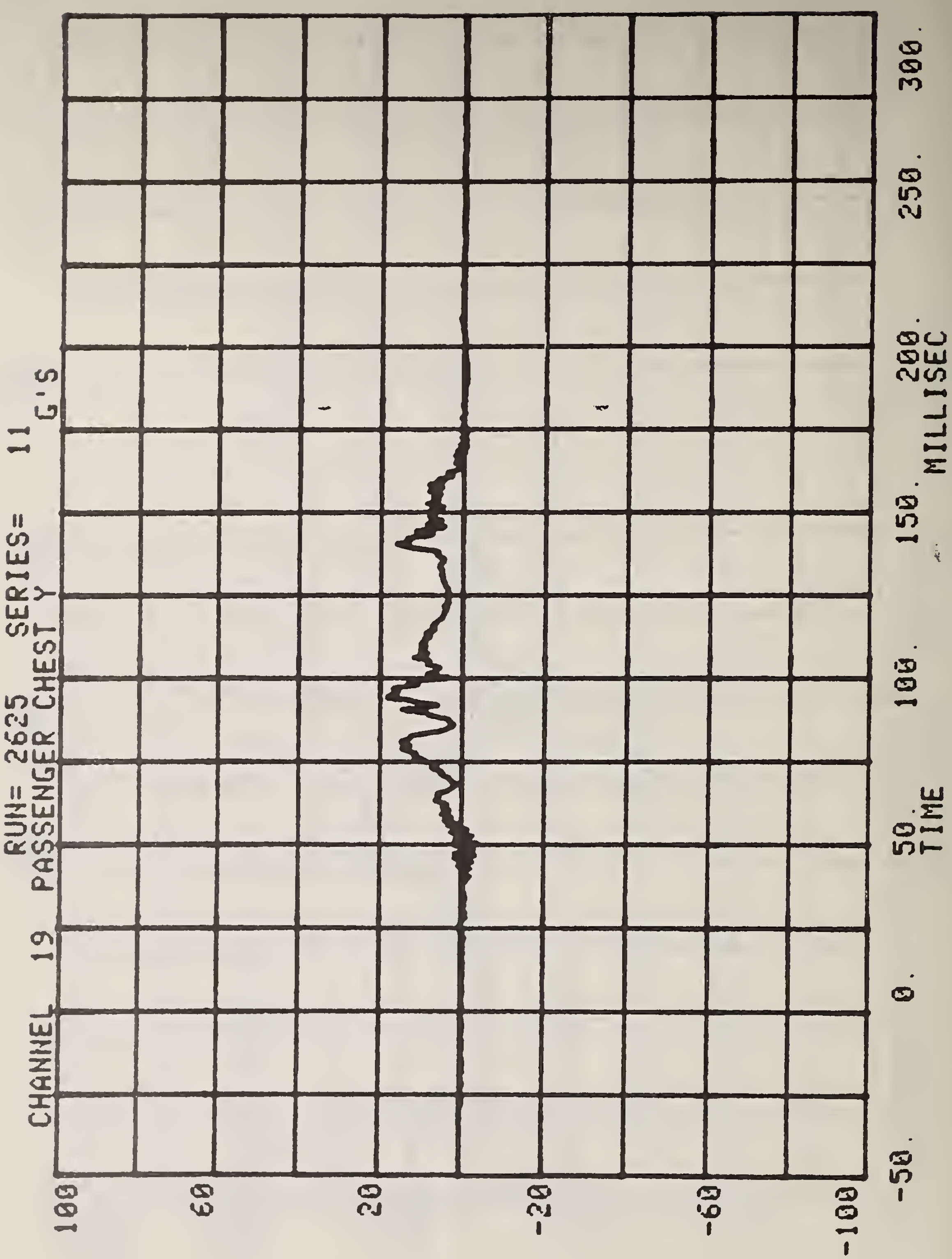

CHANNEL 11 RUN= 2625 SERIES= 11
PASSENGER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 12 RUN= 2625 SERIES= 11
PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

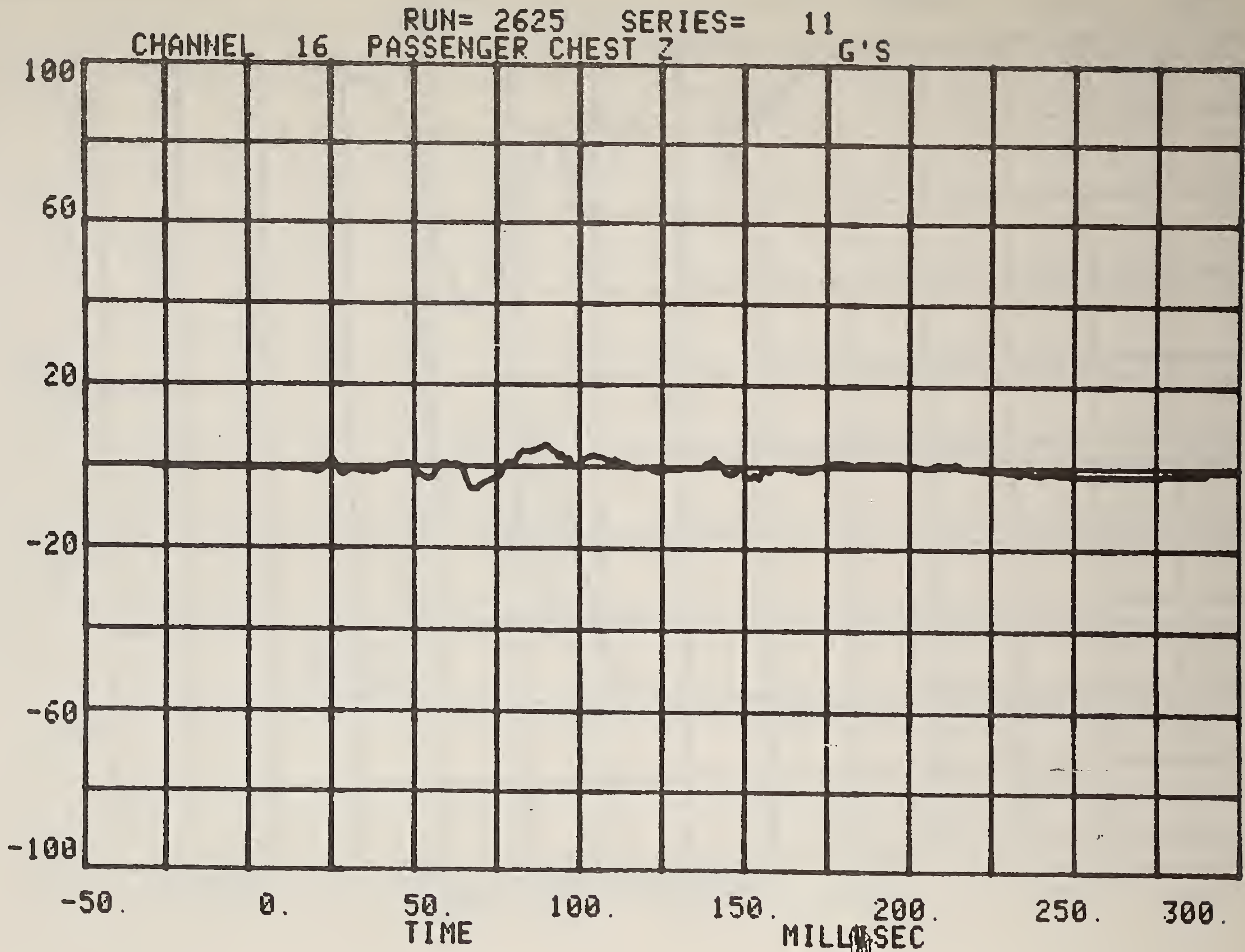

CHANNEL 13 RUN= 2625 SERIES= 11
PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

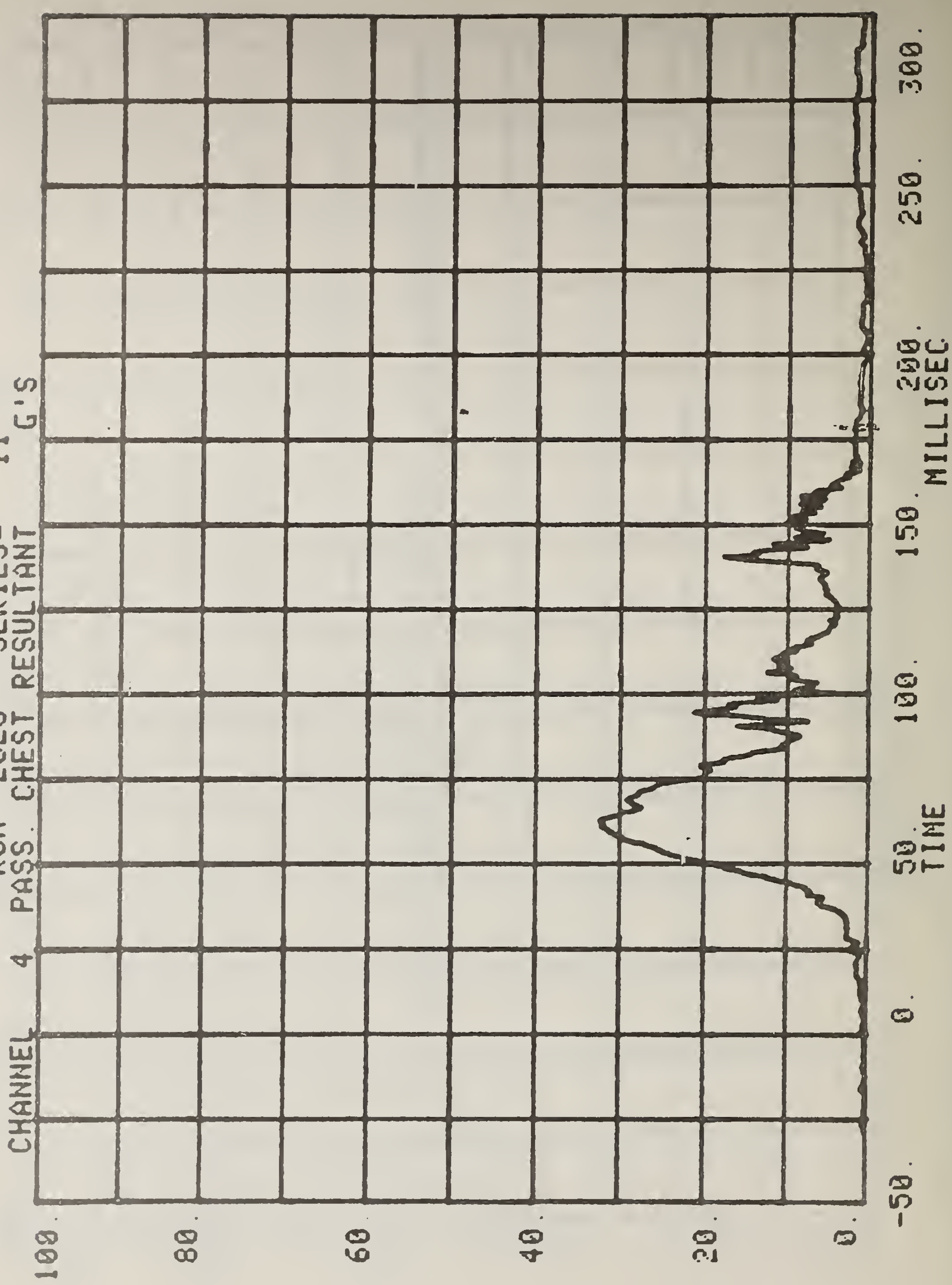

CHANNEL 3 RUN= 2625 SERIES= 11
PASS. HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

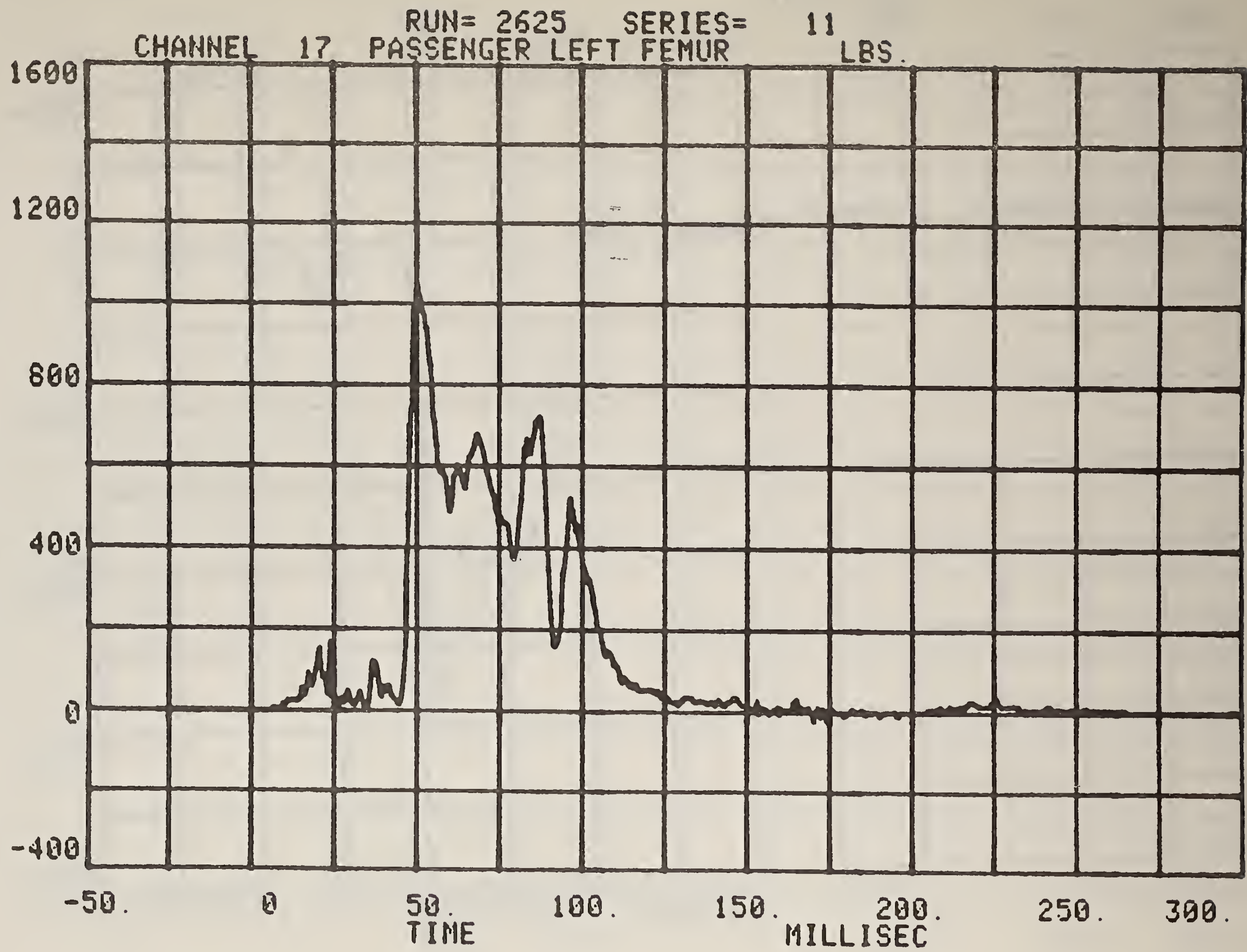

CHANNEL 14 RUN= 2625 SERIES= 11
PASSENGER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

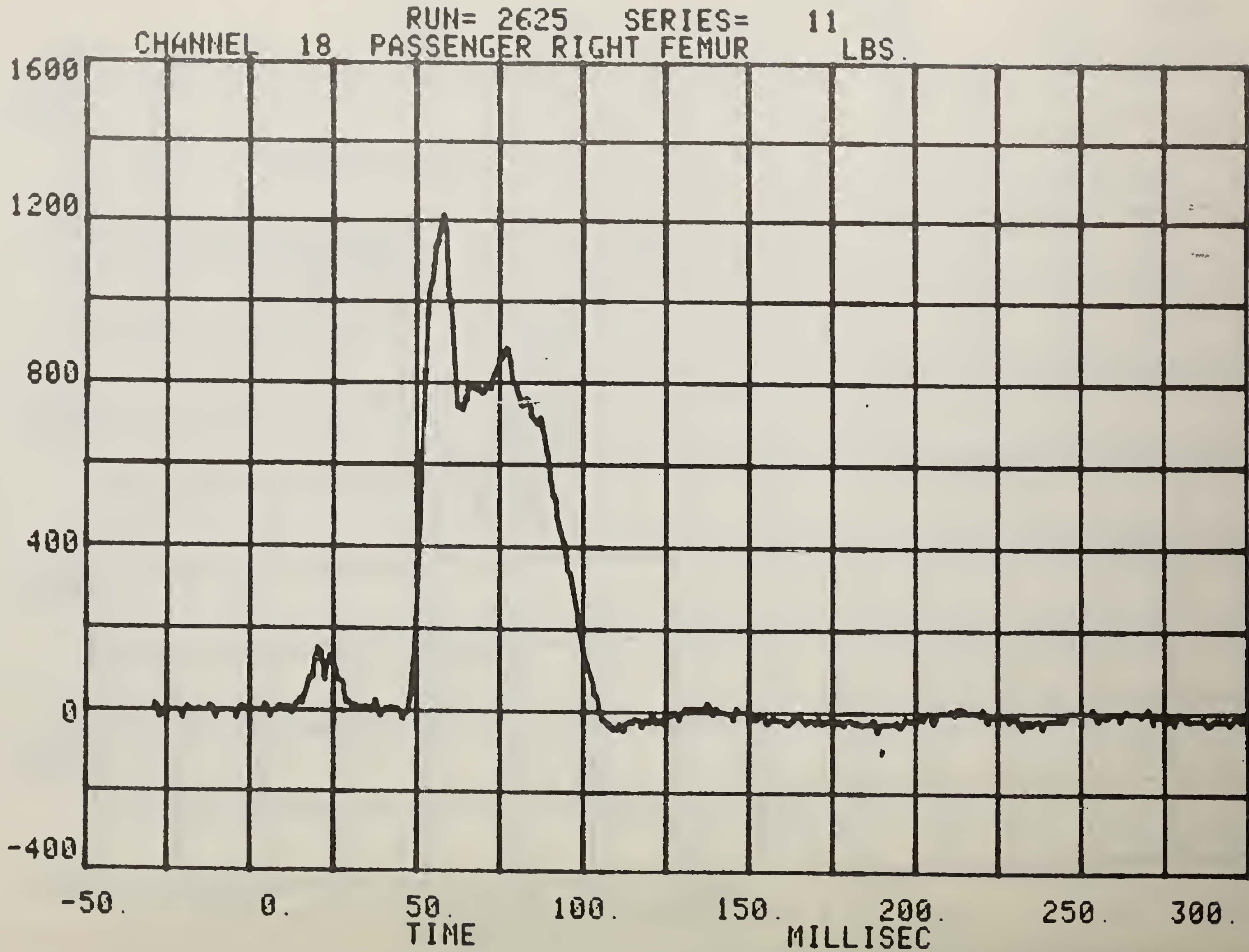


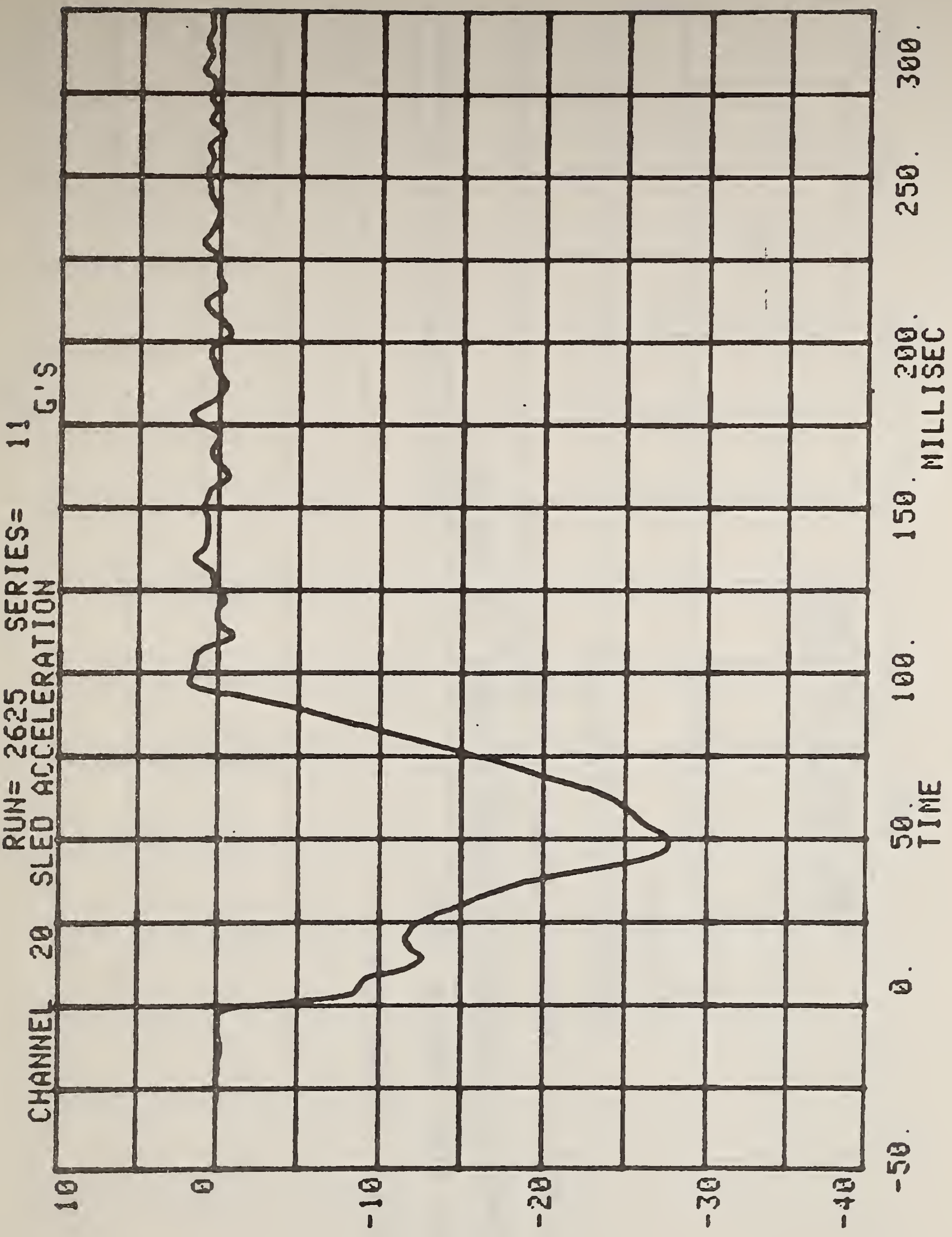
CHANNEL 19 RUN= 2625 SERIES= 11
PASSENGER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2625 SERIES= 11
CHANNEL 16 PASSENGER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 4 RUN= 2625 SERIES= 11
PASS. CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2625 SERIES= 11
CHANNEL 17 PASSENGER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2625 SERIES= 11
CHANNEL 18 PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC



CHANNEL 20 RUN= 2625 SERIES= 11
SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2626

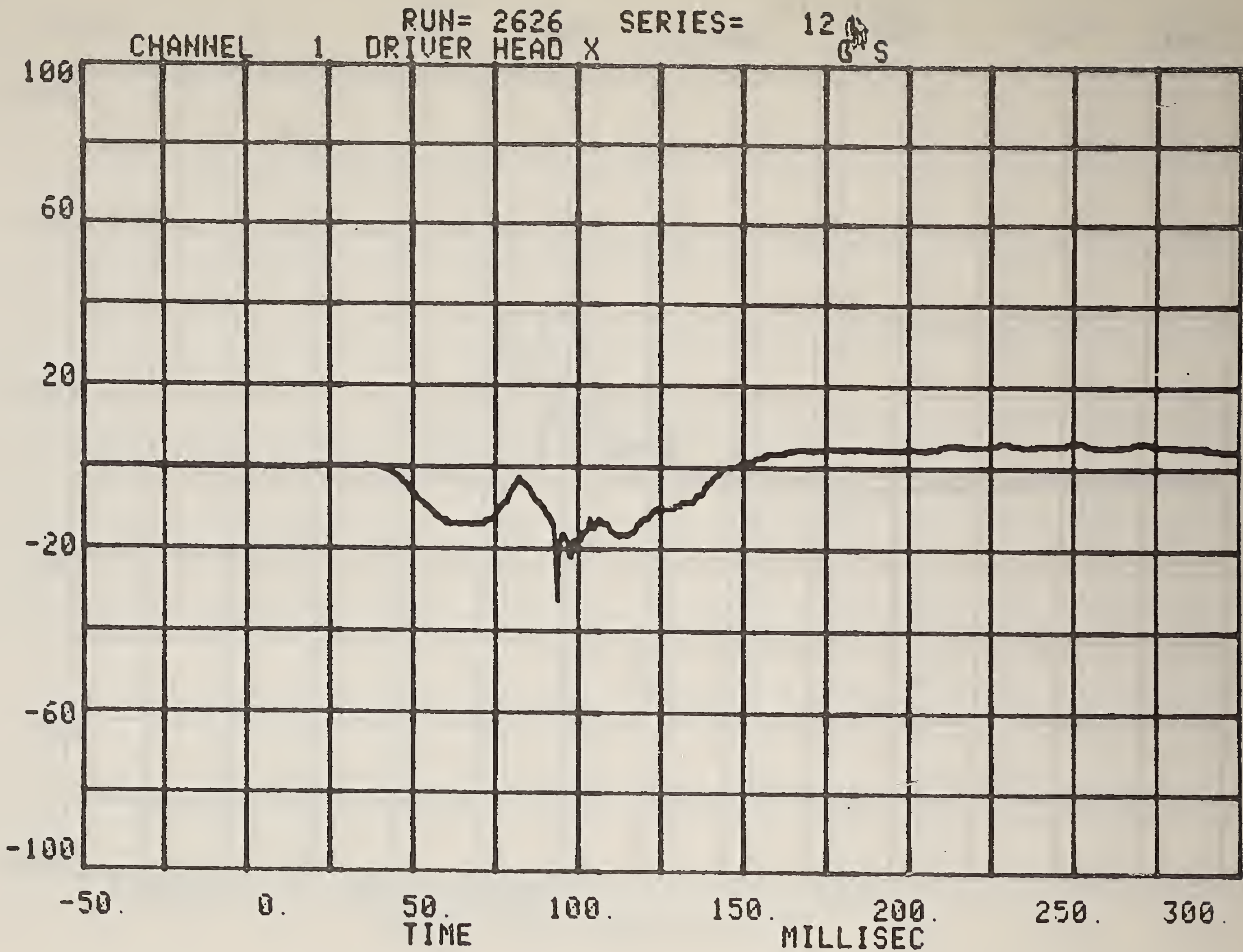
DRIVER HEAD RESULTANT

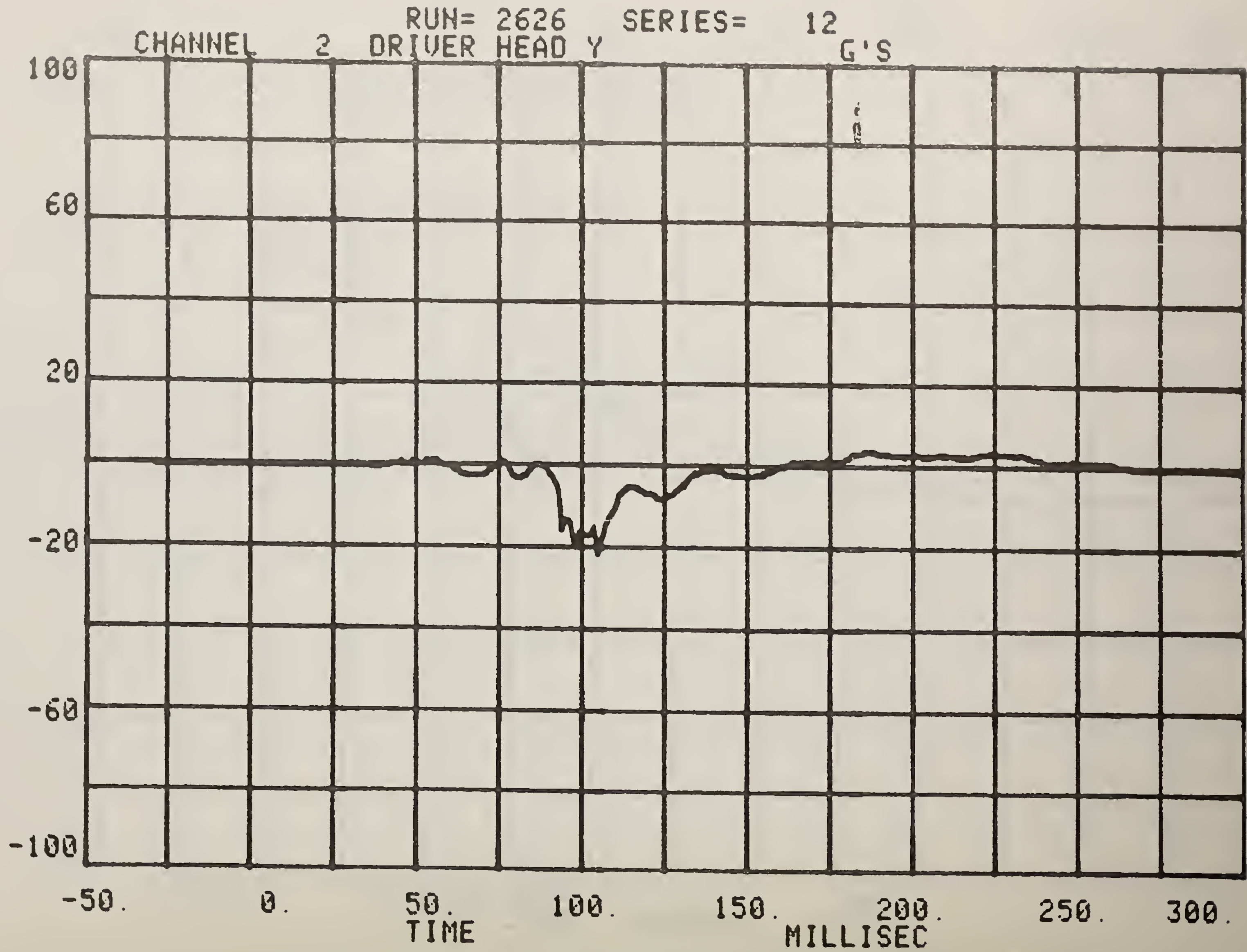
HIC= 353.8   FROM T1= .06060   TO T2= .10770

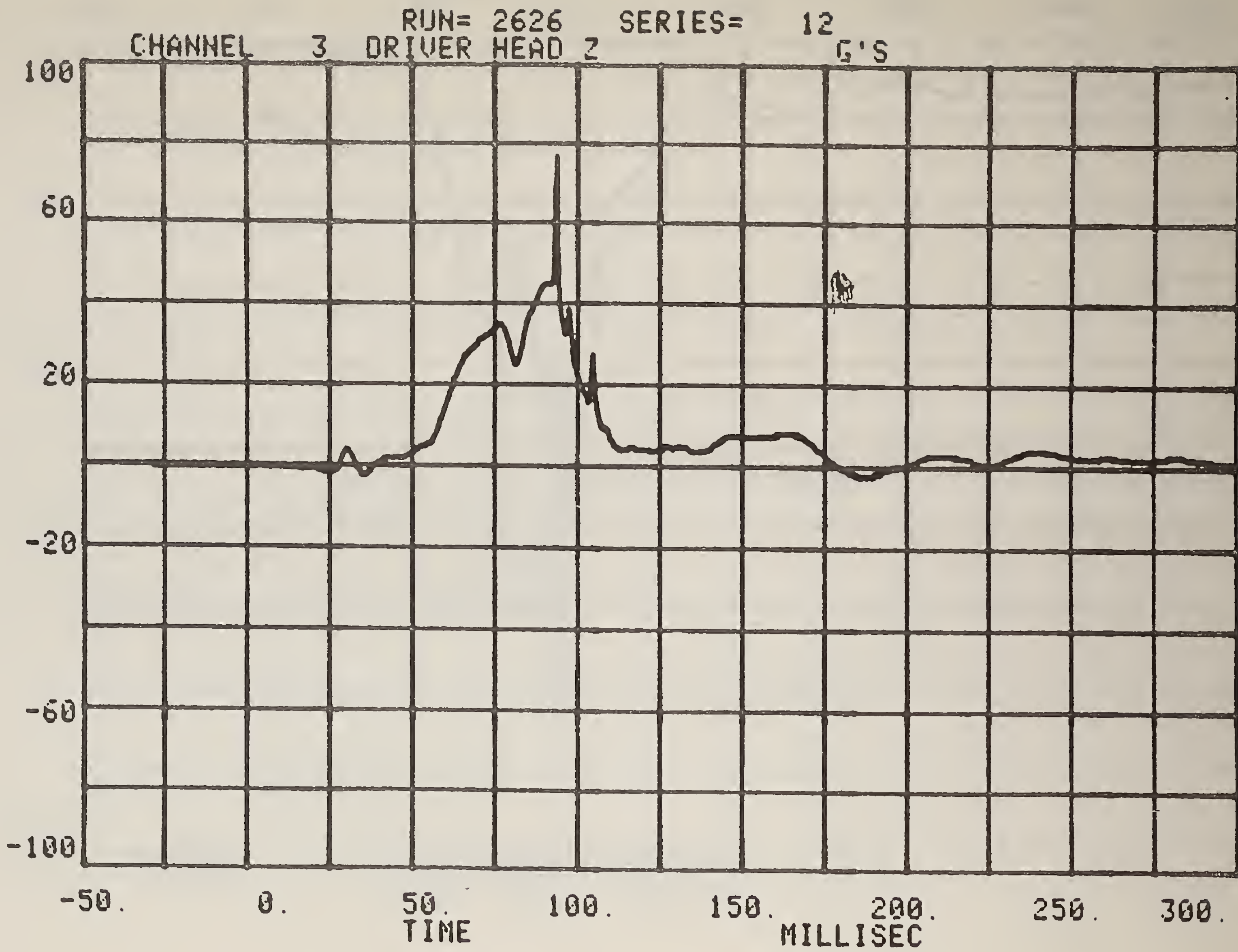
AVERAGE ACCELERATION BETWEEN T1 AND T2= 35.5G'S

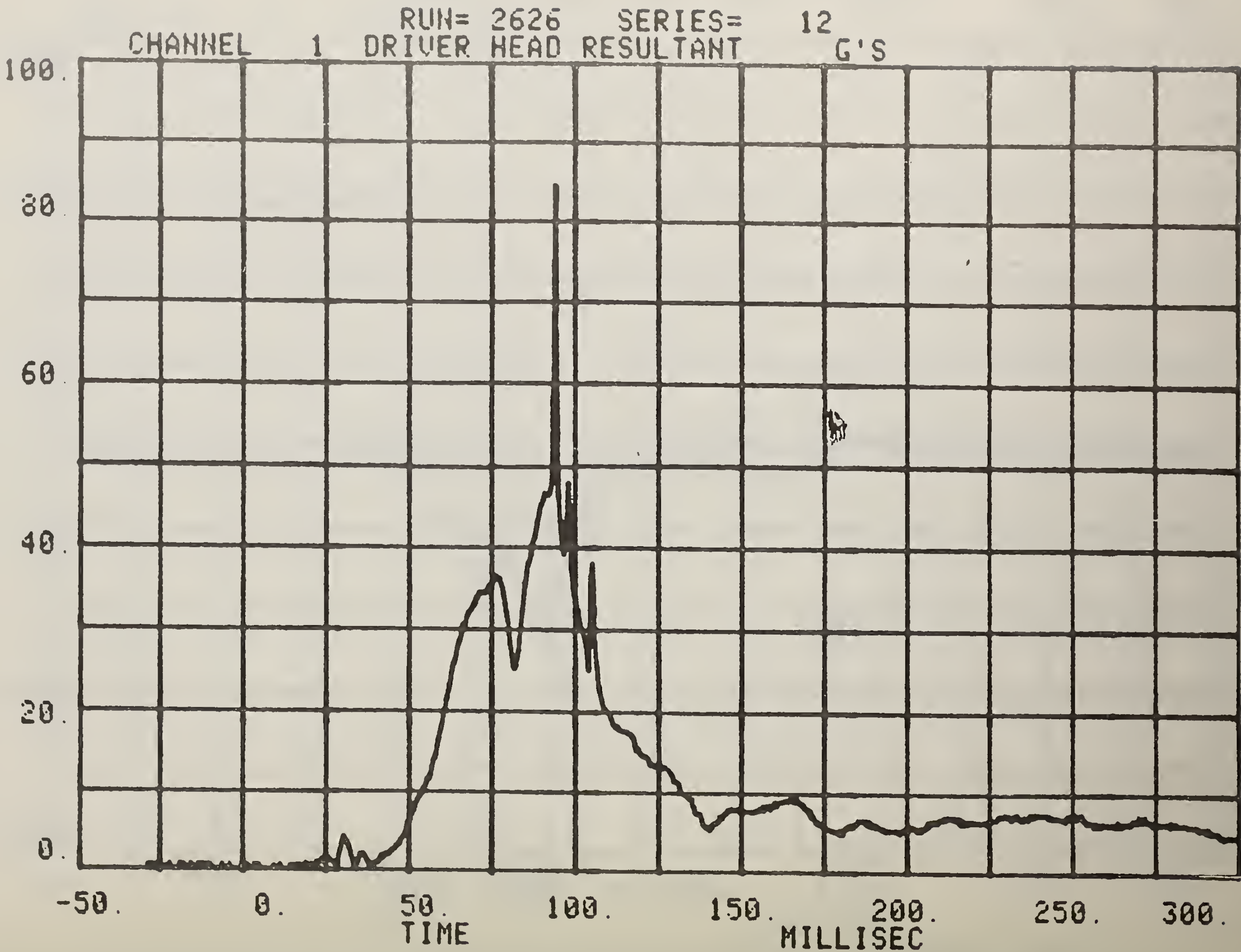
EVENT TIME= 300.0 MSEC

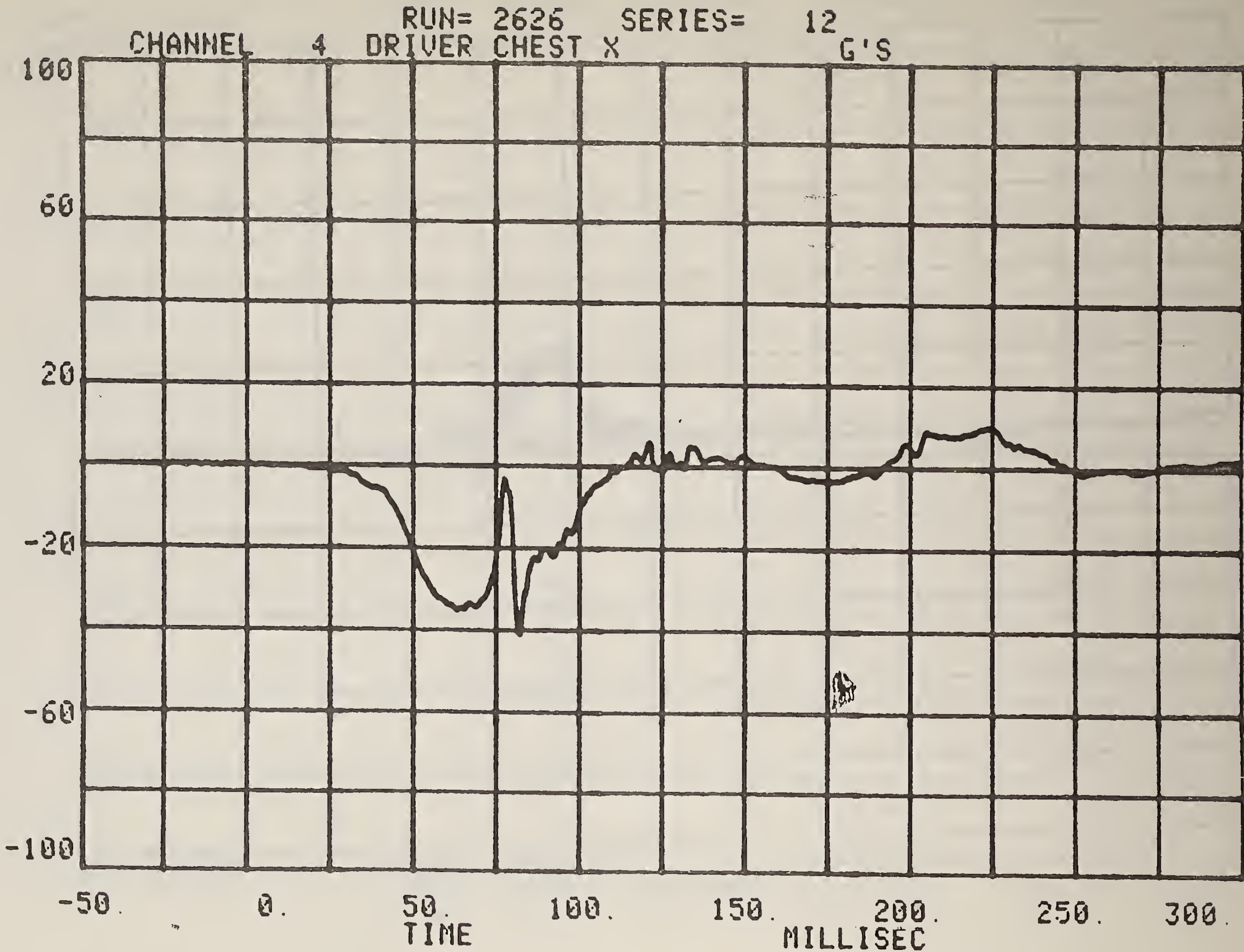
SEVERITY INDEX= 459.6

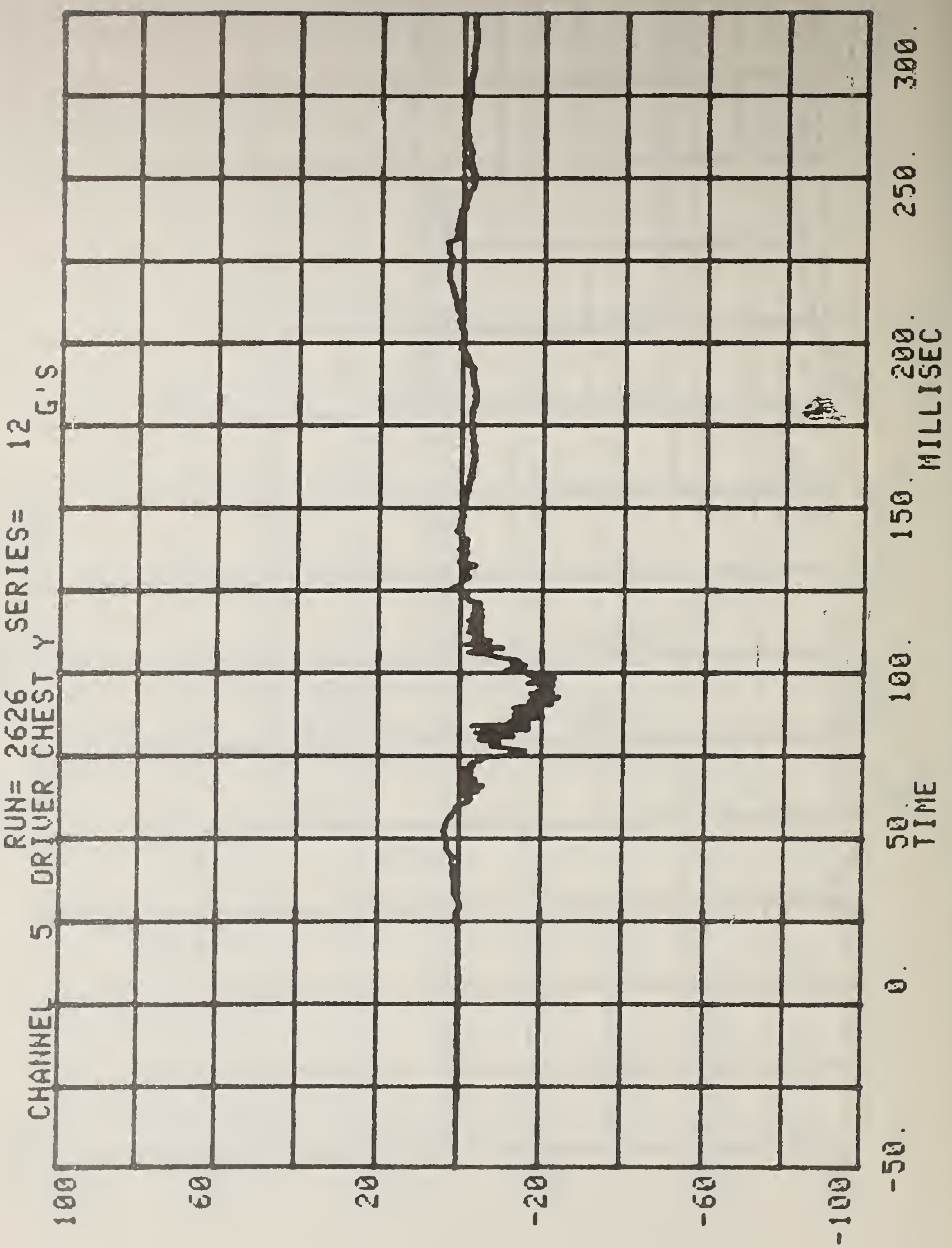

RUN= 2626 SERIES= 12
CHANNEL 1 DRIVER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2626 SERIES= 12
CHANNEL 2 DRIVER HEAD Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

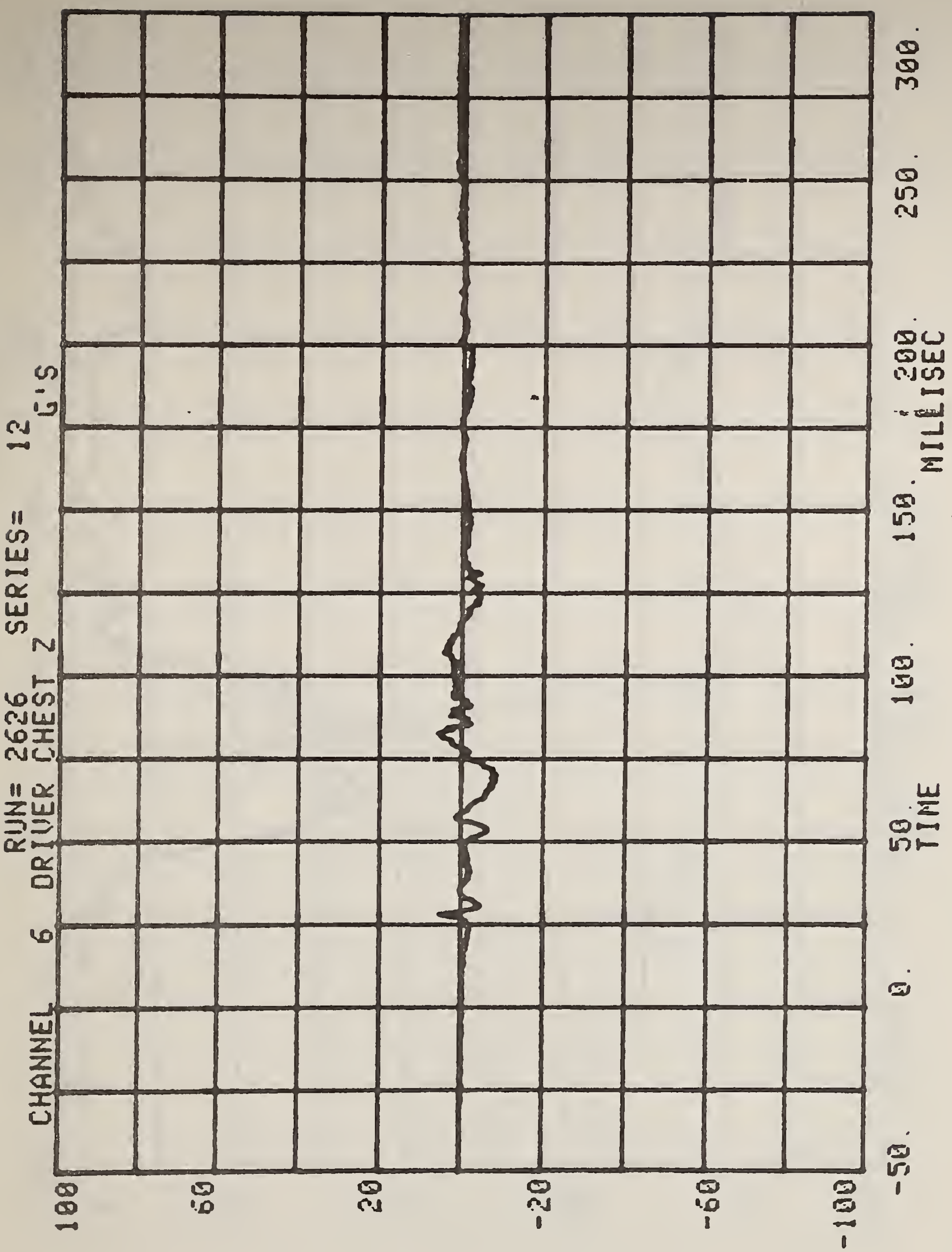

RUN= 2626 SERIES= 12
CHANNEL 3 DRIVER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

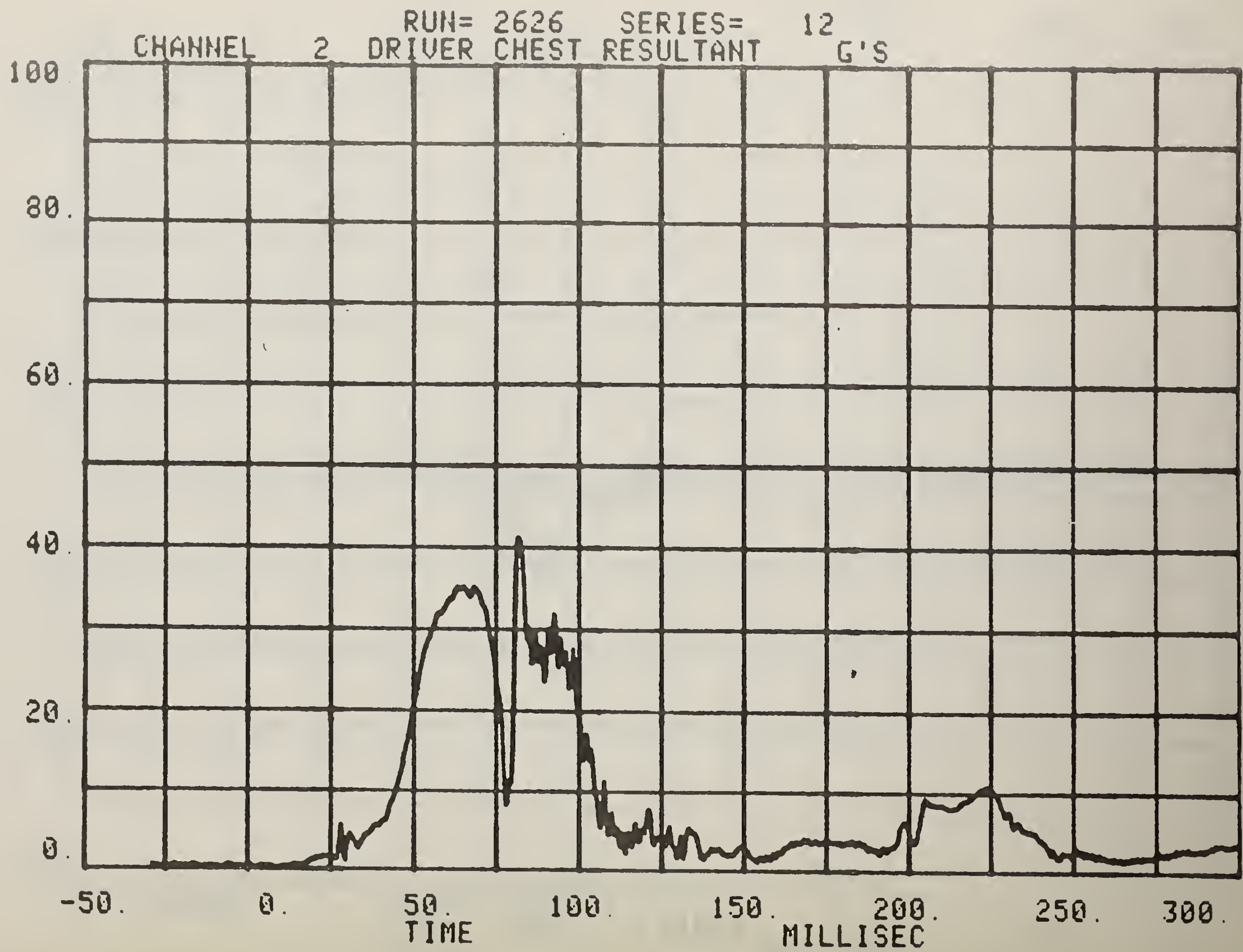

RUN= 2626 SERIES= 12
CHANNEL 1 DRIVER HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

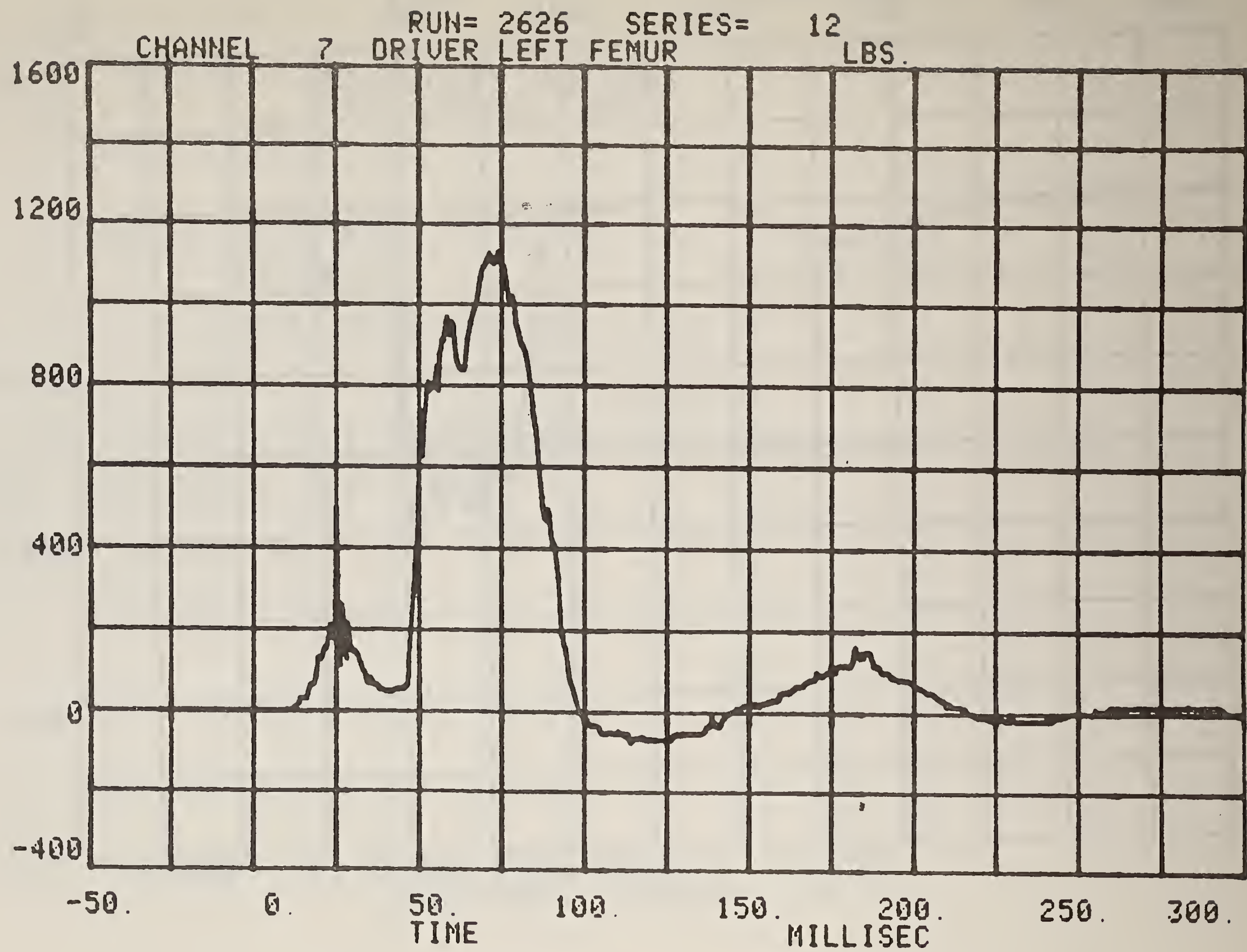

RUN= 2626 SERIES= 12
CHANNEL 4 DRIVER CHEST X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

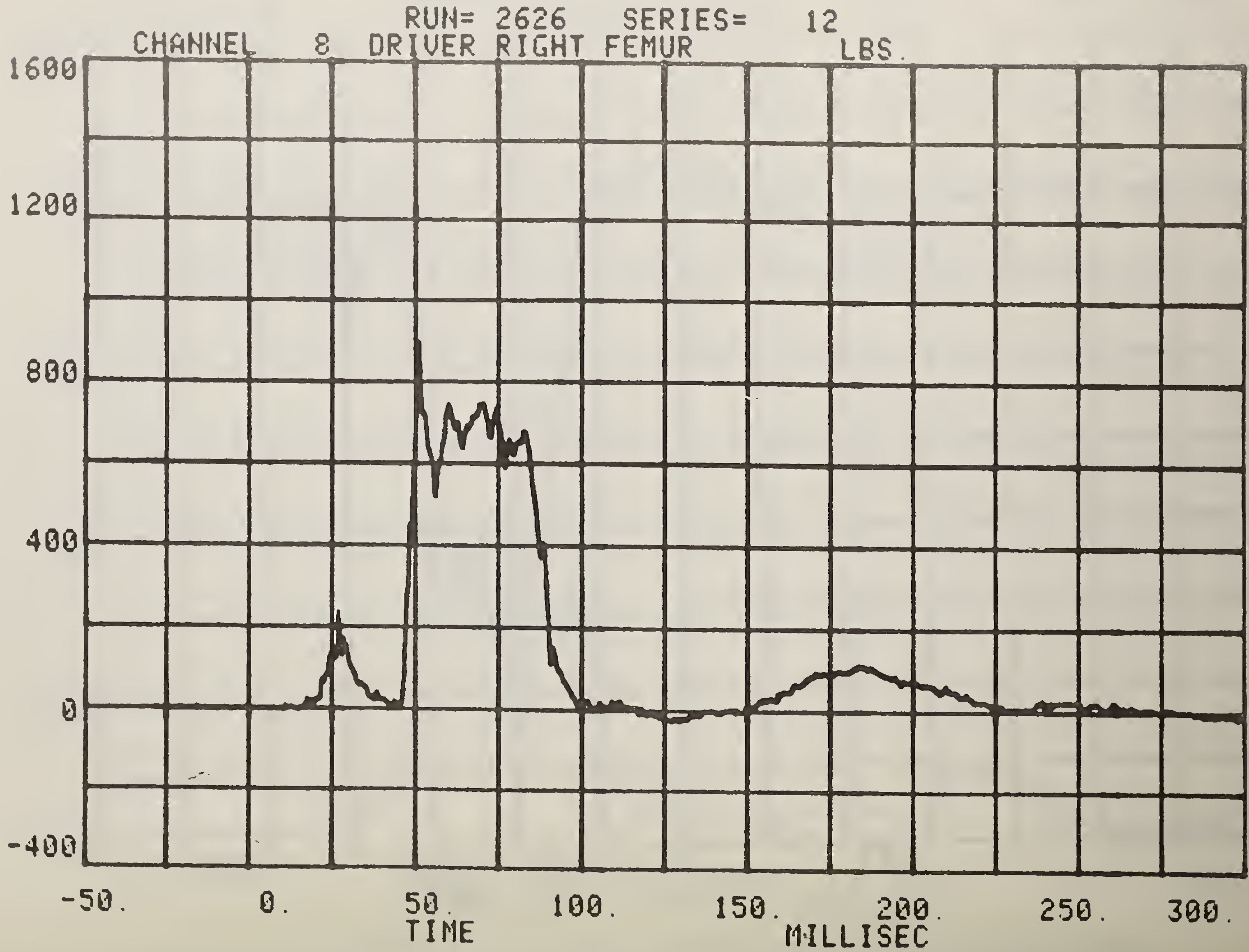


CHANNEL 5 RUN= 2626 SERIES= 12
DRIVER CHEST Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 6 RUN= 2626 SERIES= 12
DRIVER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2626 SERIES= 12
CHANNEL 2 DRIVER CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2626 SERIES= 12
CHANNEL 7 DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2626 SERIES= 12
CHANNEL 8 DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2626

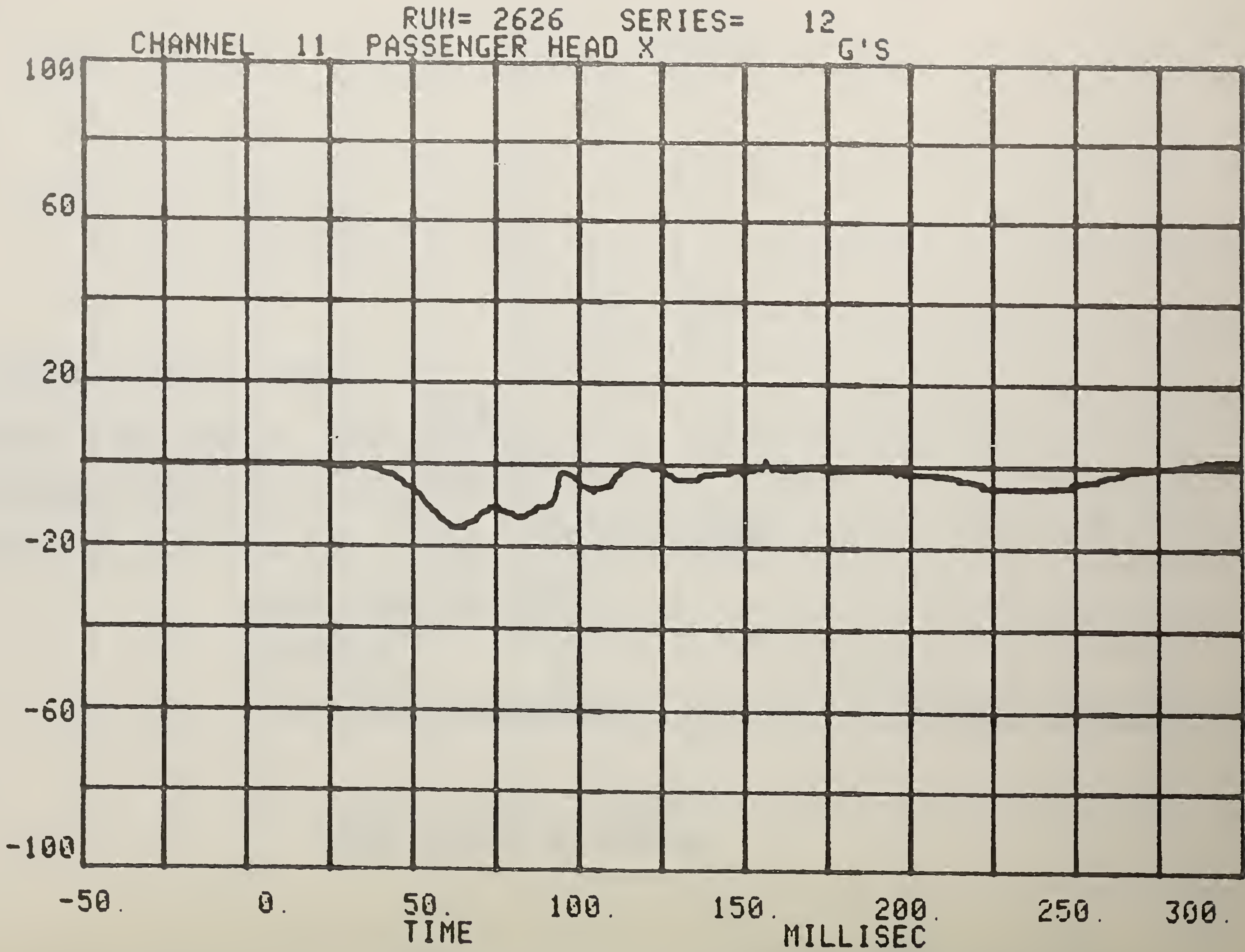
PASS. HEAD RESULTANT

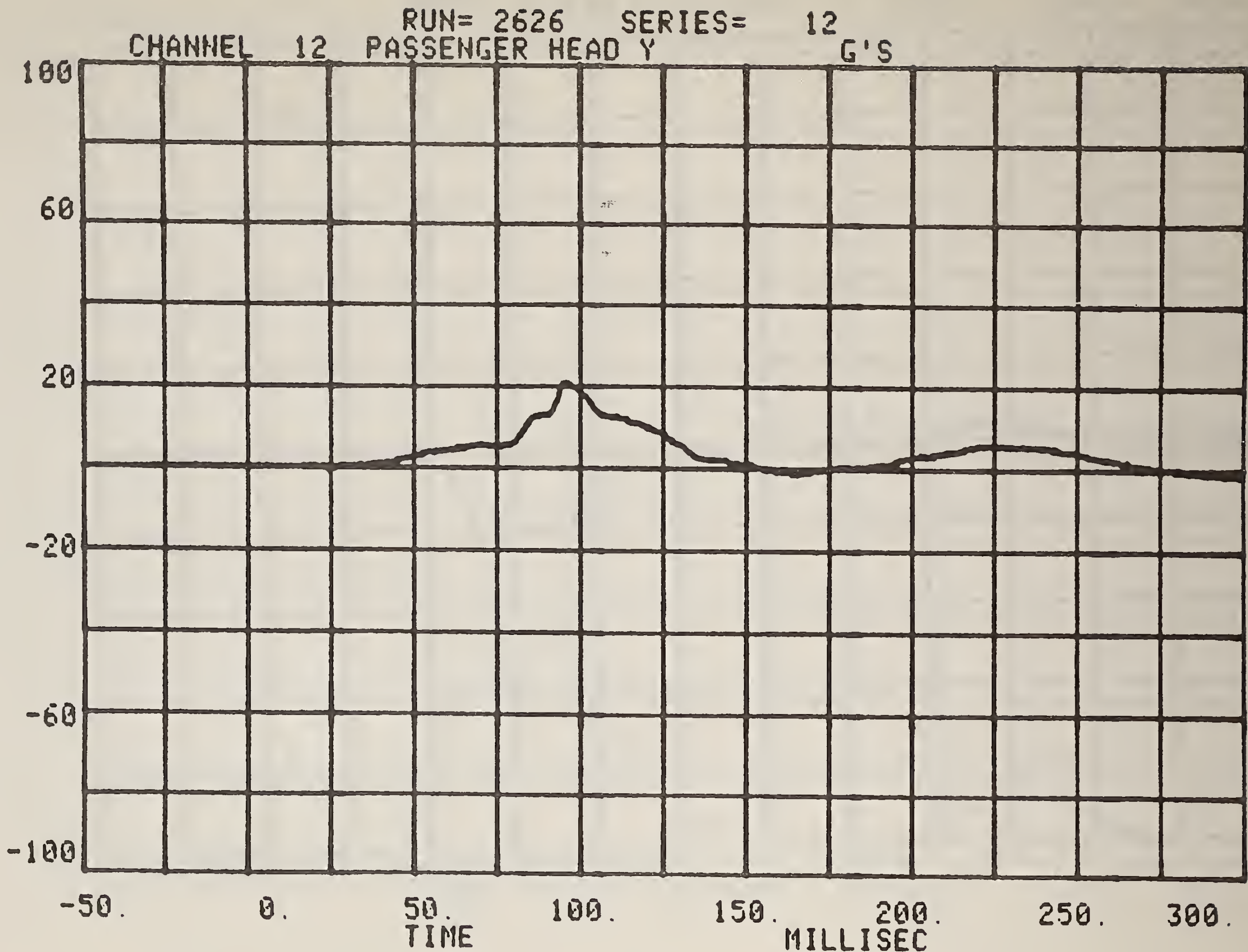
HIC= 156.0   FROM T1= .05670   TO T2= .10890

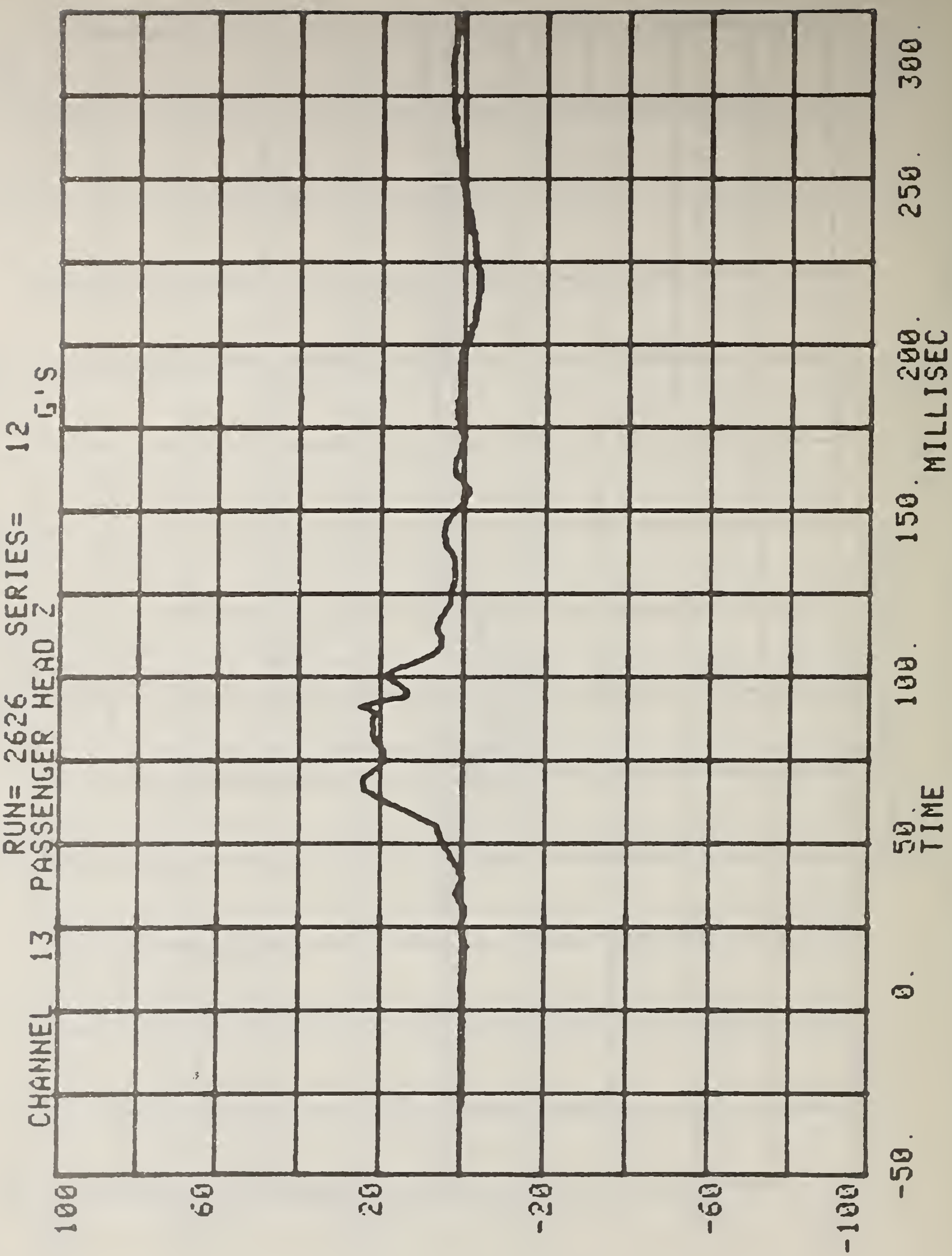
AVERAGE ACCELERATION BETWEEN T1 AND T2= 24.6G'S

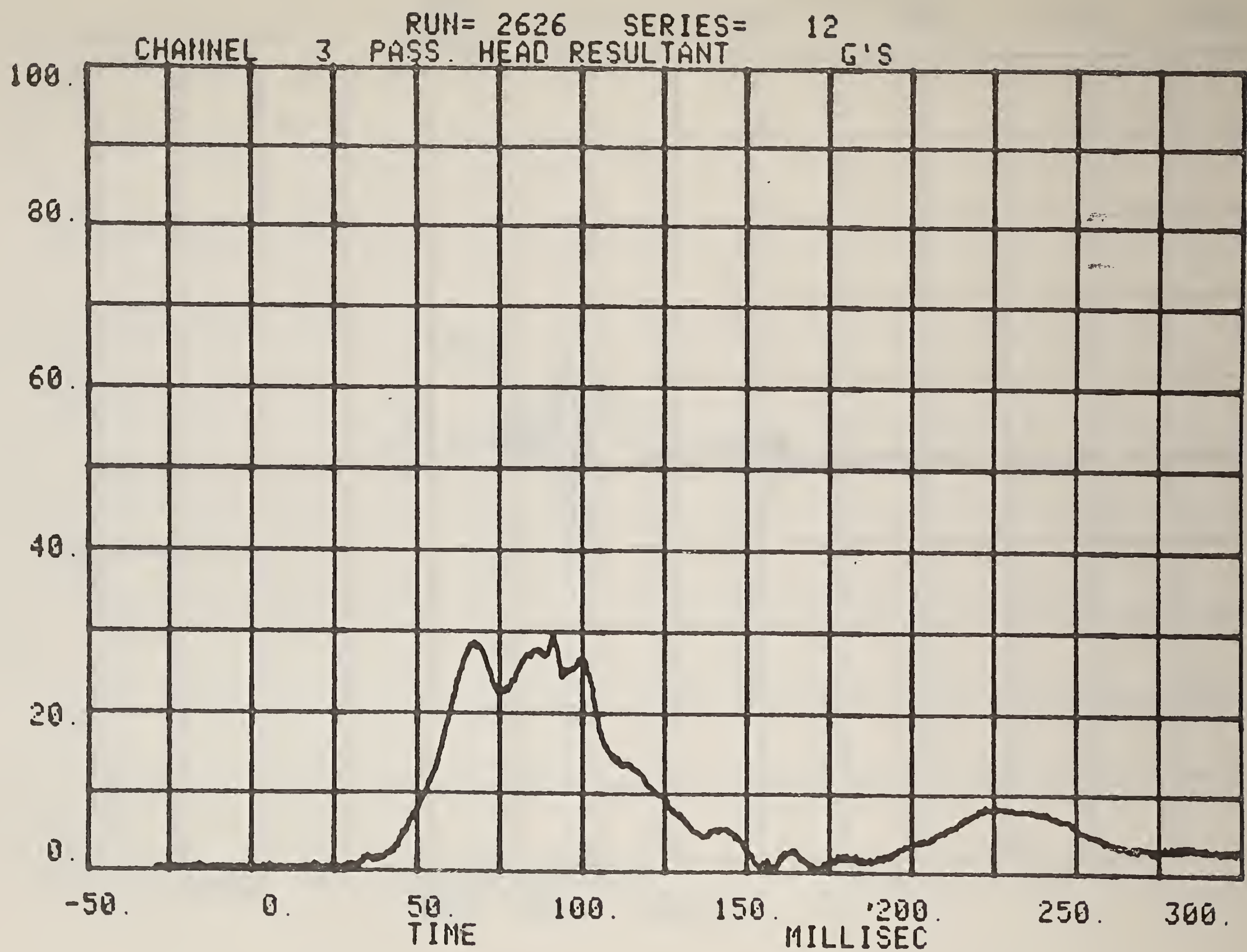
EVENT TIME= 300.0 MSEC

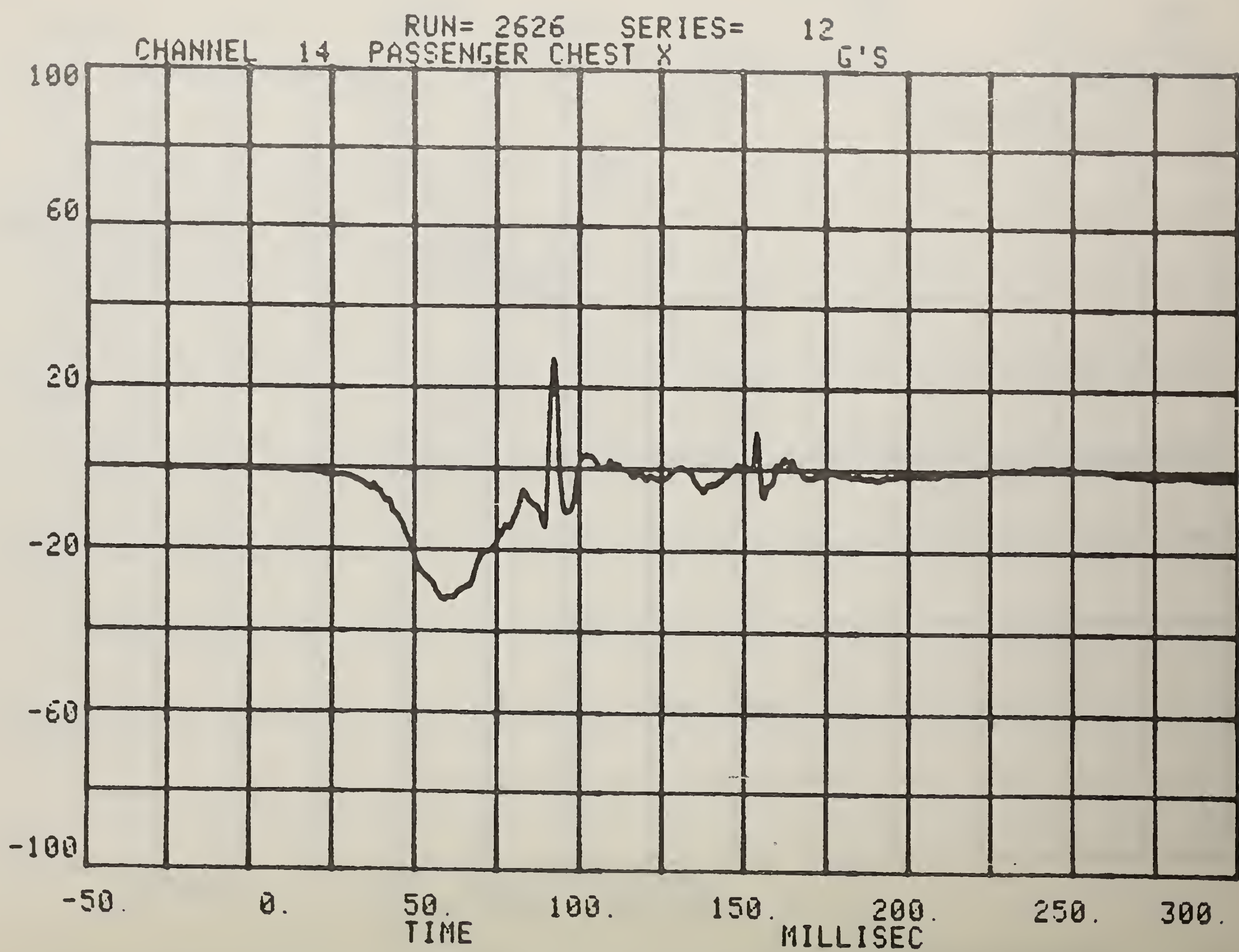
SEVERITY INDEX= 185.5

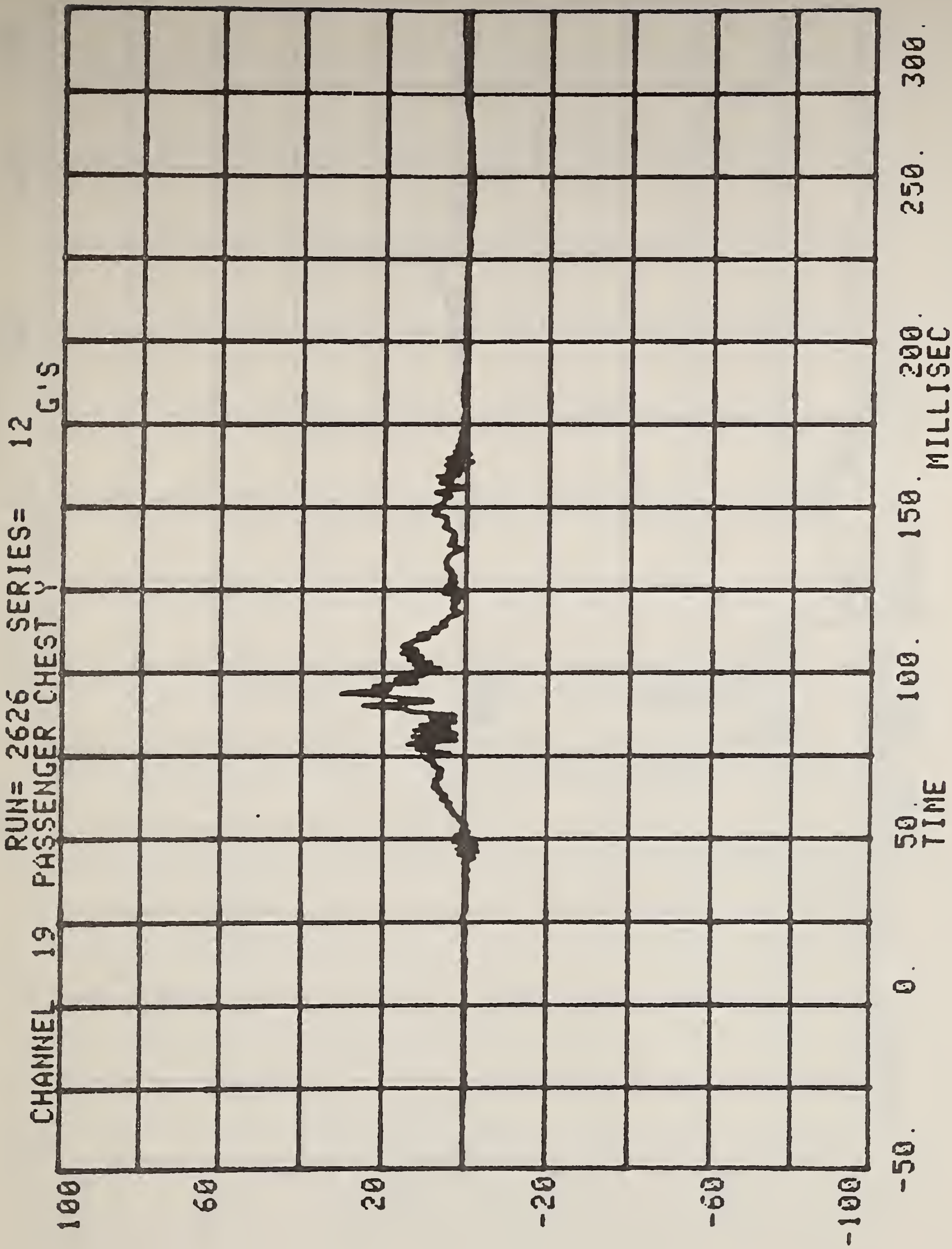

RUN= 2626 SERIES= 12
CHANNEL 11 PASSENGER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

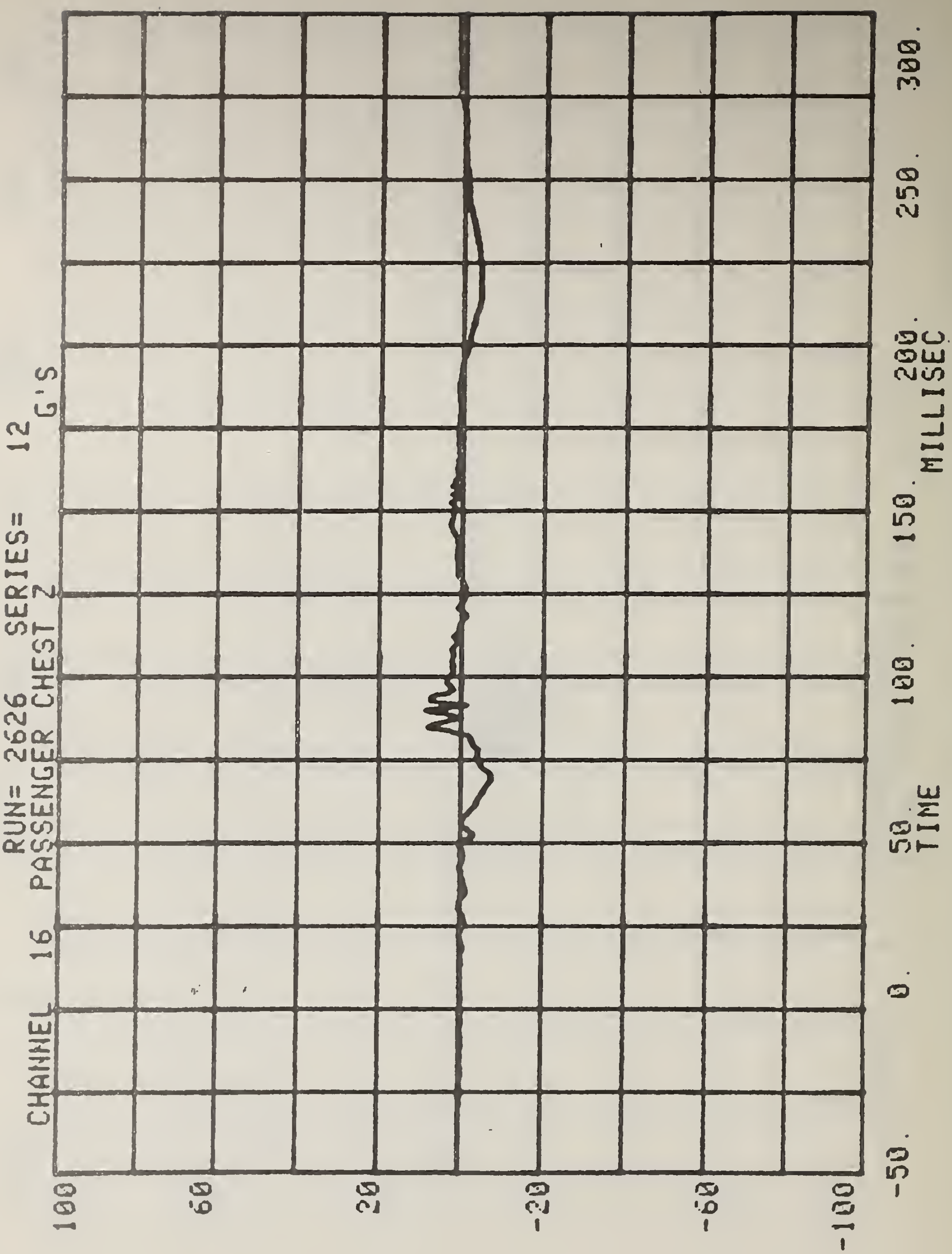

RUN= 2626 SERIES= 12
CHANNEL 12 PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

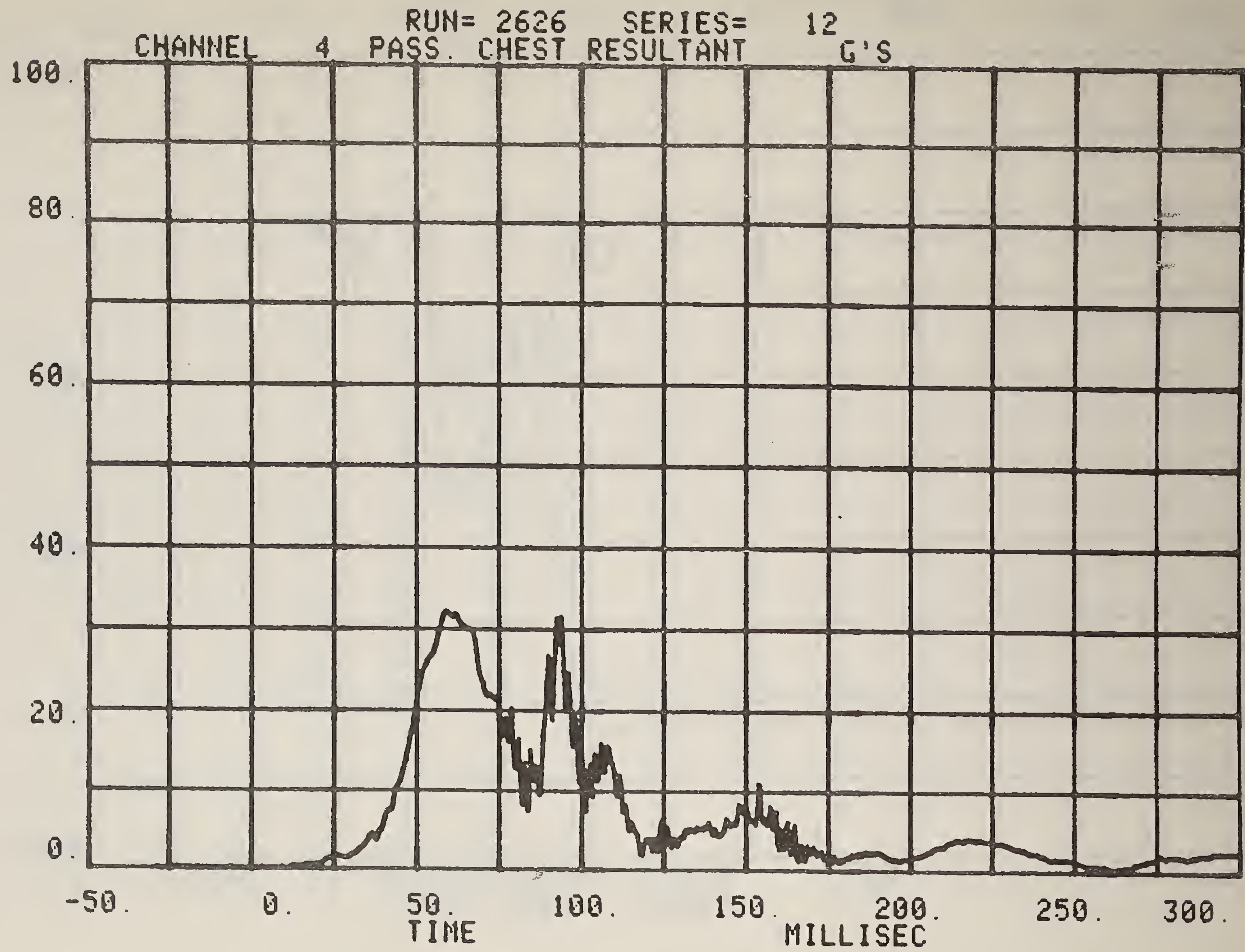

CHANNEL 13 RUN= 2626 SERIES= 12
PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

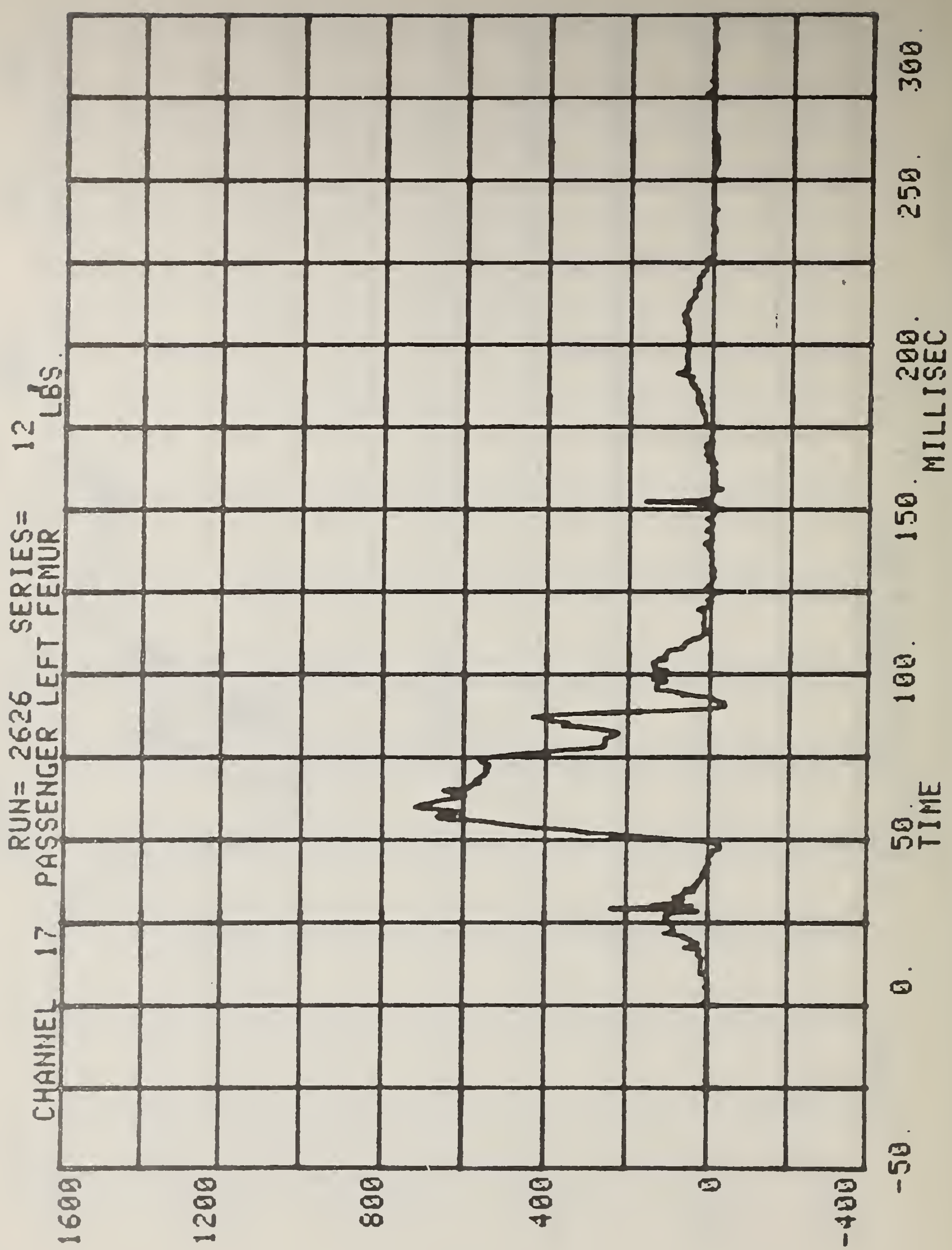

RUN= 2626 SERIES= 12
CHANNEL 3 PASS. HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

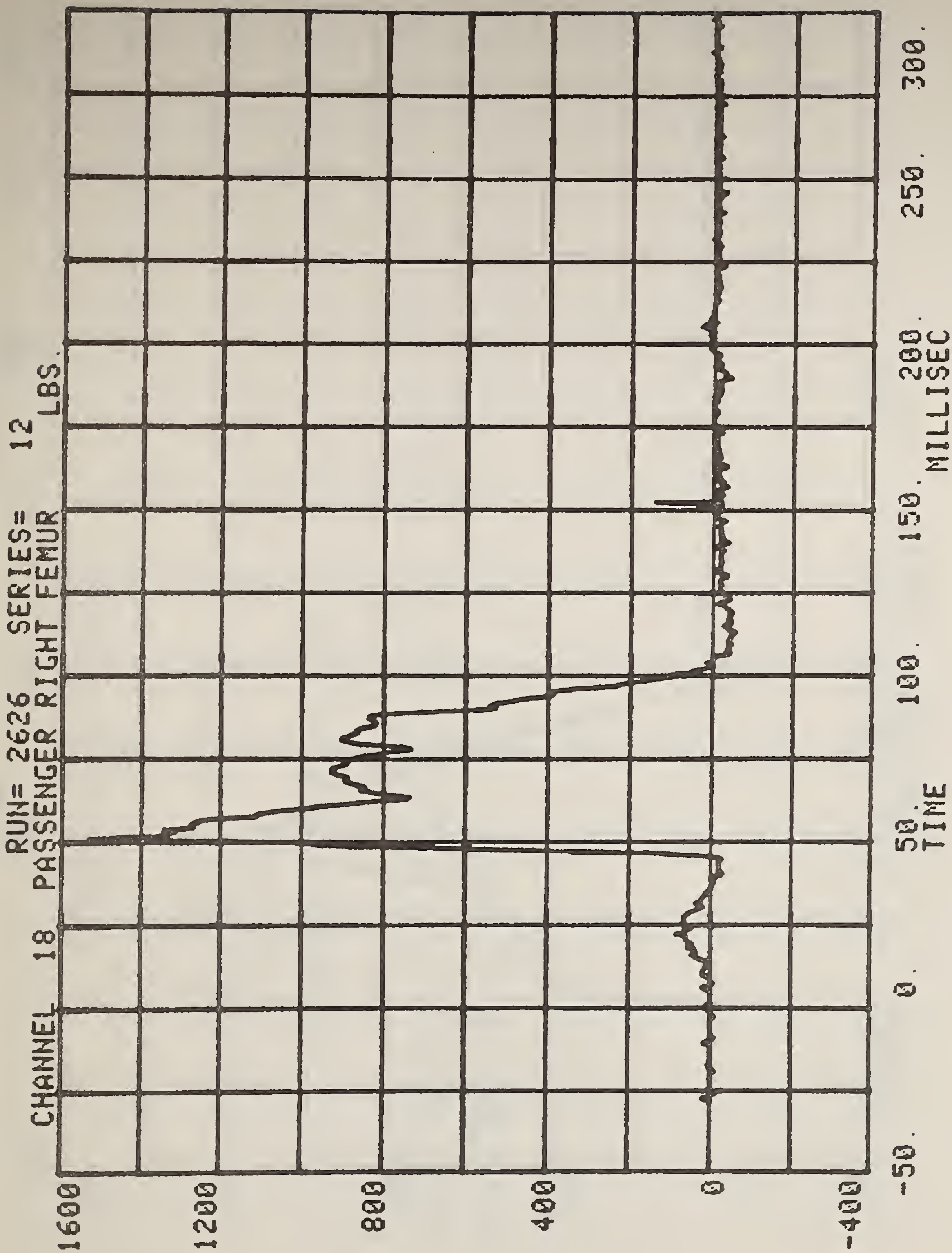

RUN= 2626 SERIES= 12
CHANNEL 14 PASSENGER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 19 RUN= 2626 SERIES= 12
PASSENGER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

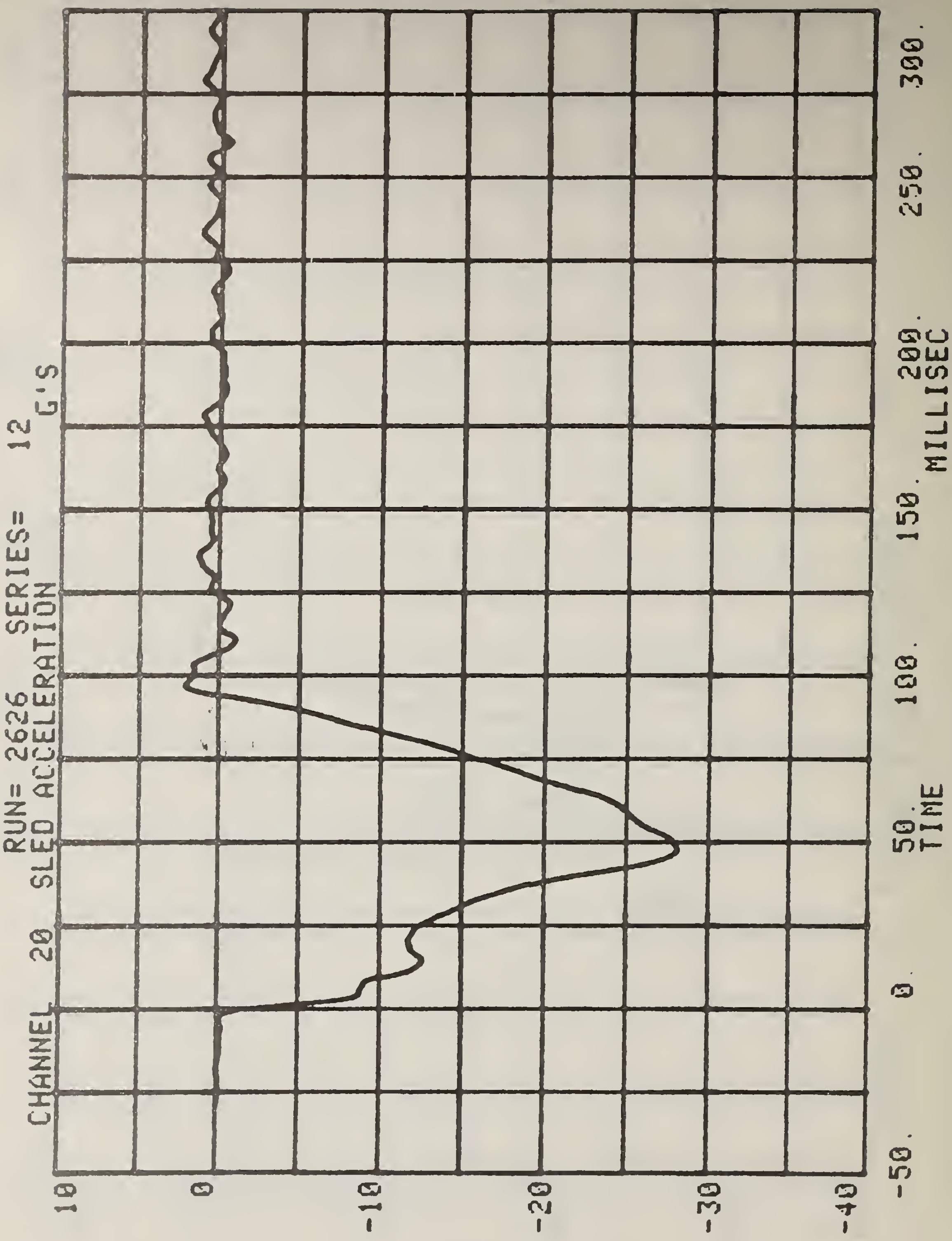

CHANNEL 16 RUN= 2626 SERIES= 12
PASSENGER CHEST Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2626 SERIES= 12
CHANNEL 4 PASS. CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 17 RUN= 2626 SERIES= 12
PASSENGER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



CHANNEL 18 RUN= 2626 SERIES= 12
PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



CHANNEL 20 RUN= 2626 SERIES= 12
SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2627

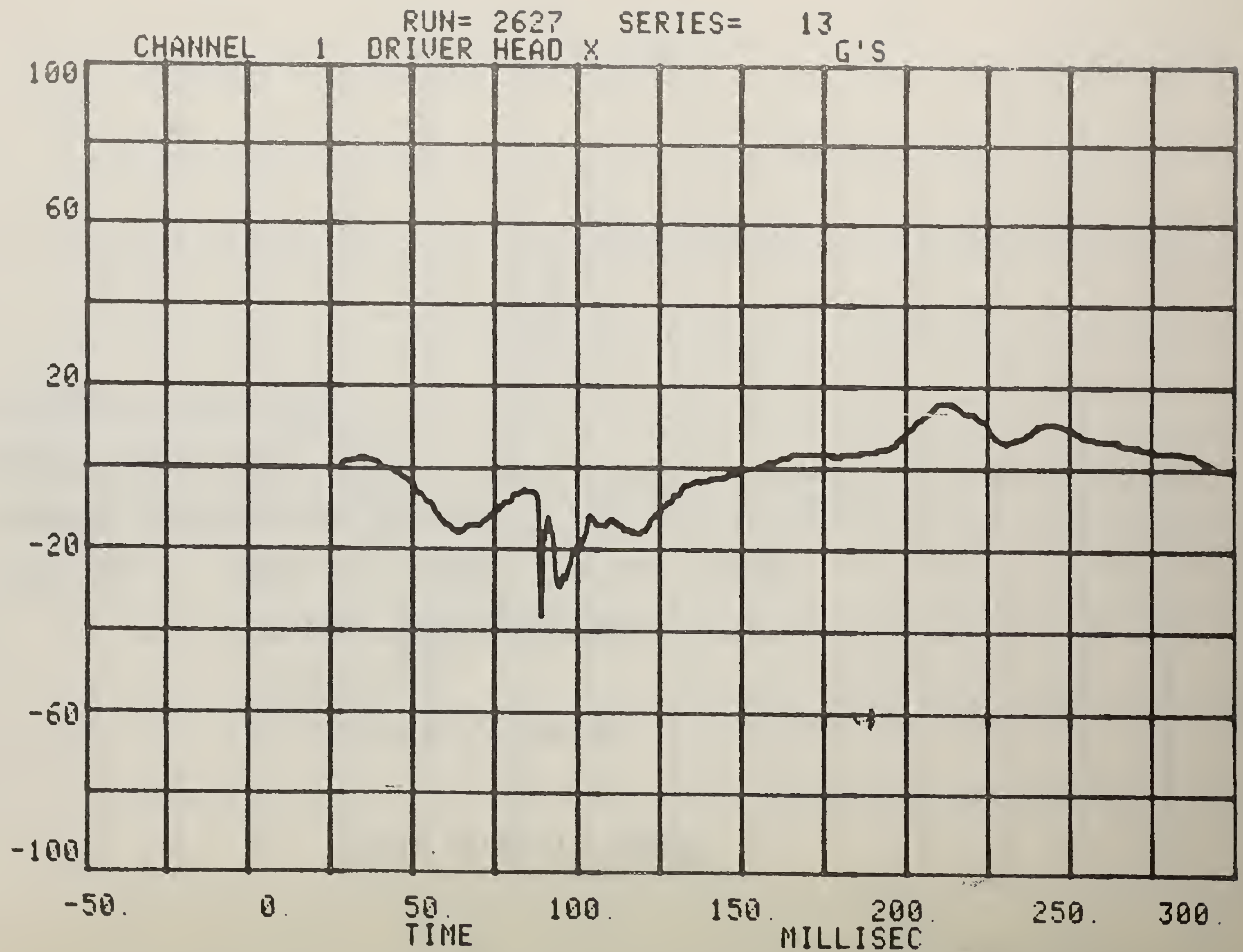
DRIVER HEAD RESULTANT

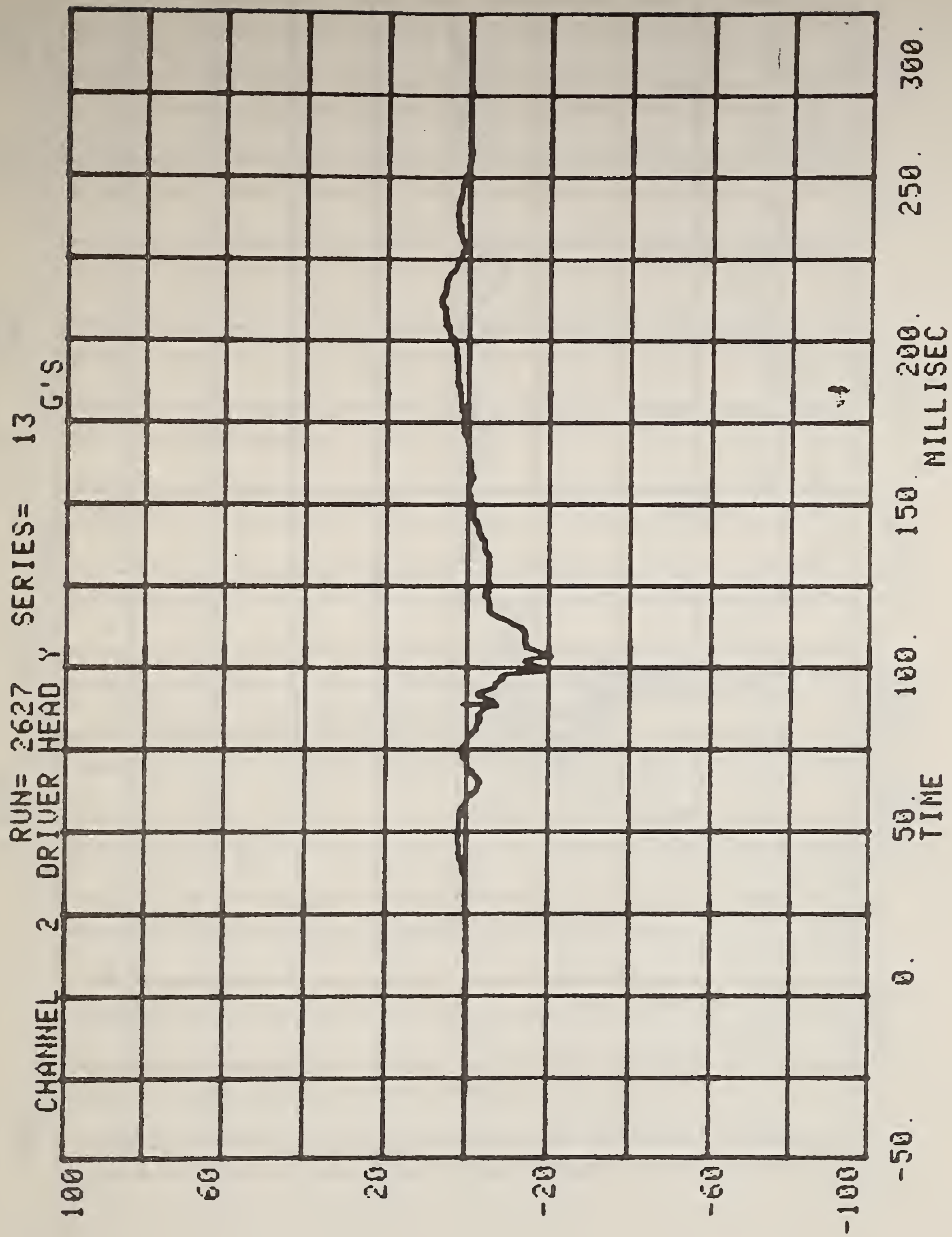
HIC= 381.4   FROM T1= .06030   TO T2= .11400

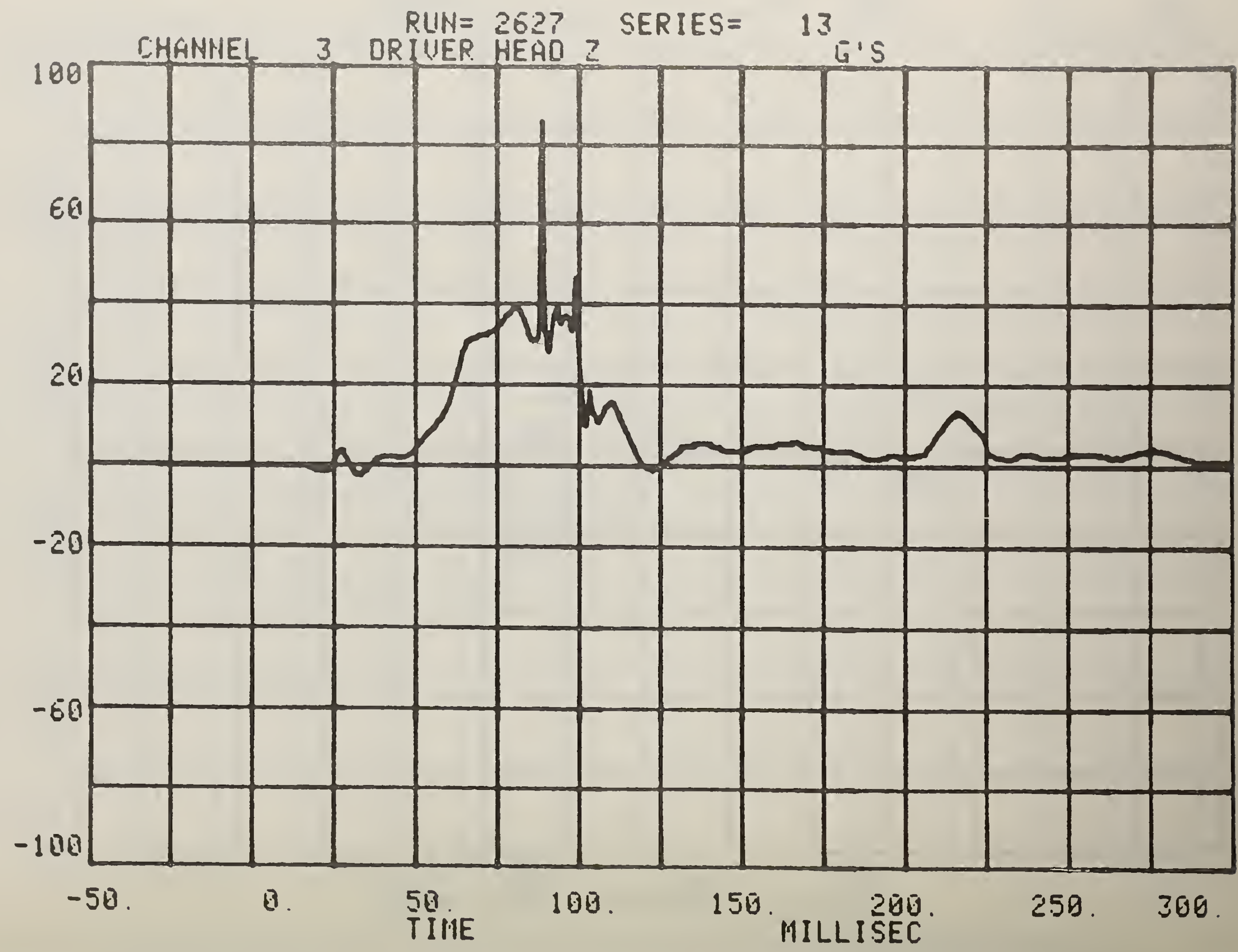
AVERAGE ACCELERATION BETWEEN T1 AND T2= 34.7G'S

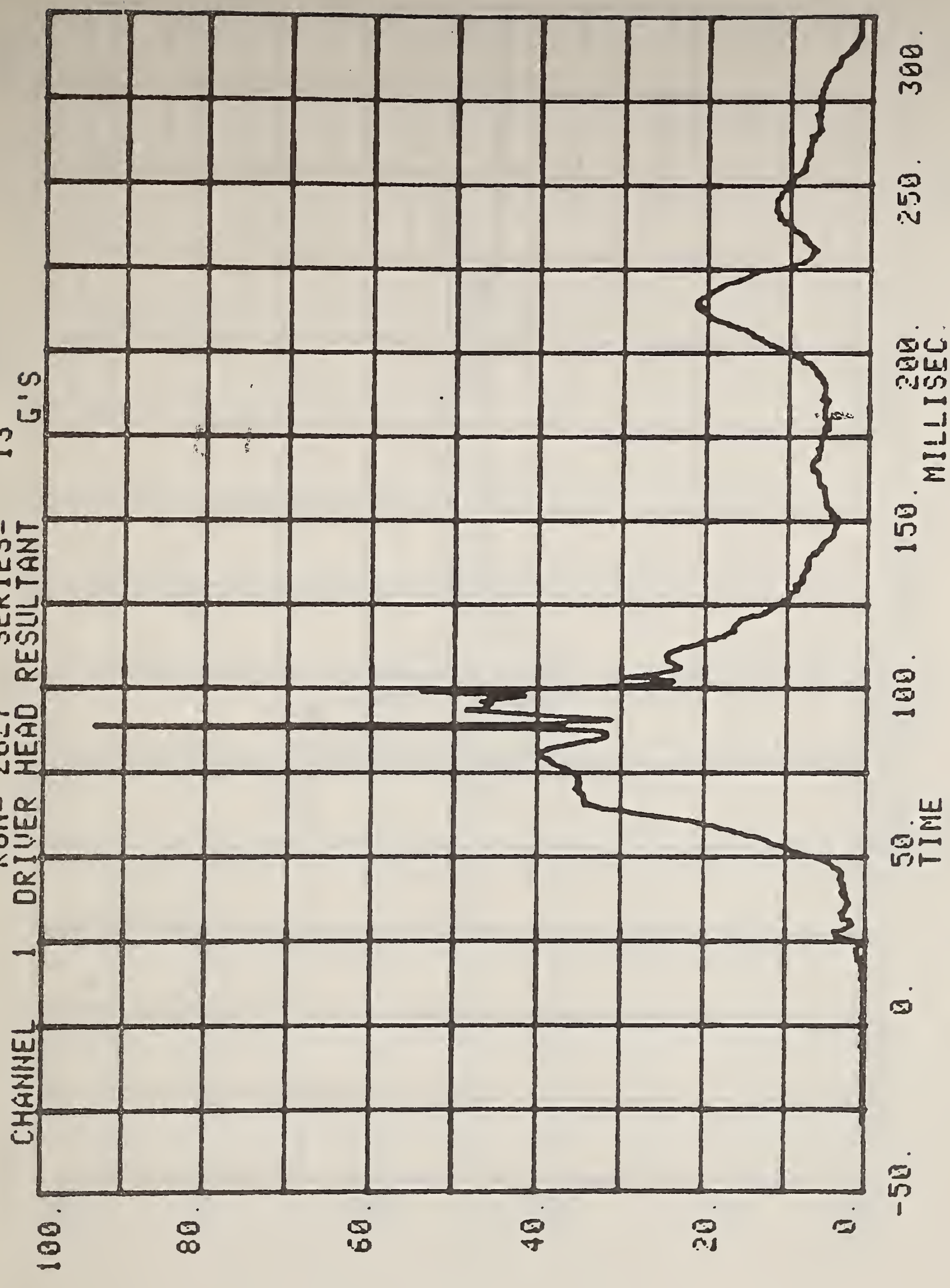
EVENT TIME= 300.0 MSEC

SEVERITY INDEX= 521.5

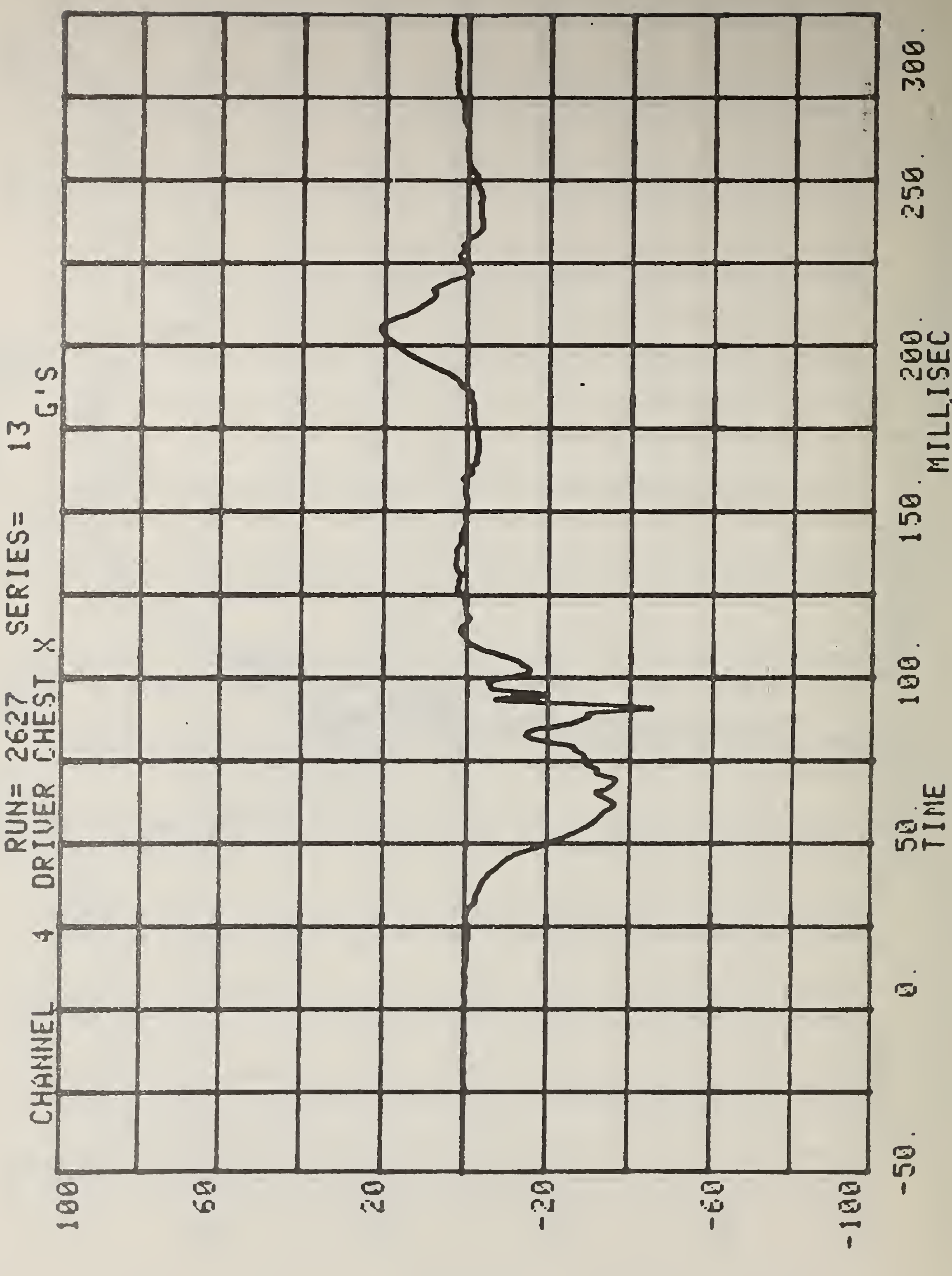

RUN= 2627 SERIES= 13
CHANNEL 1 DRIVER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

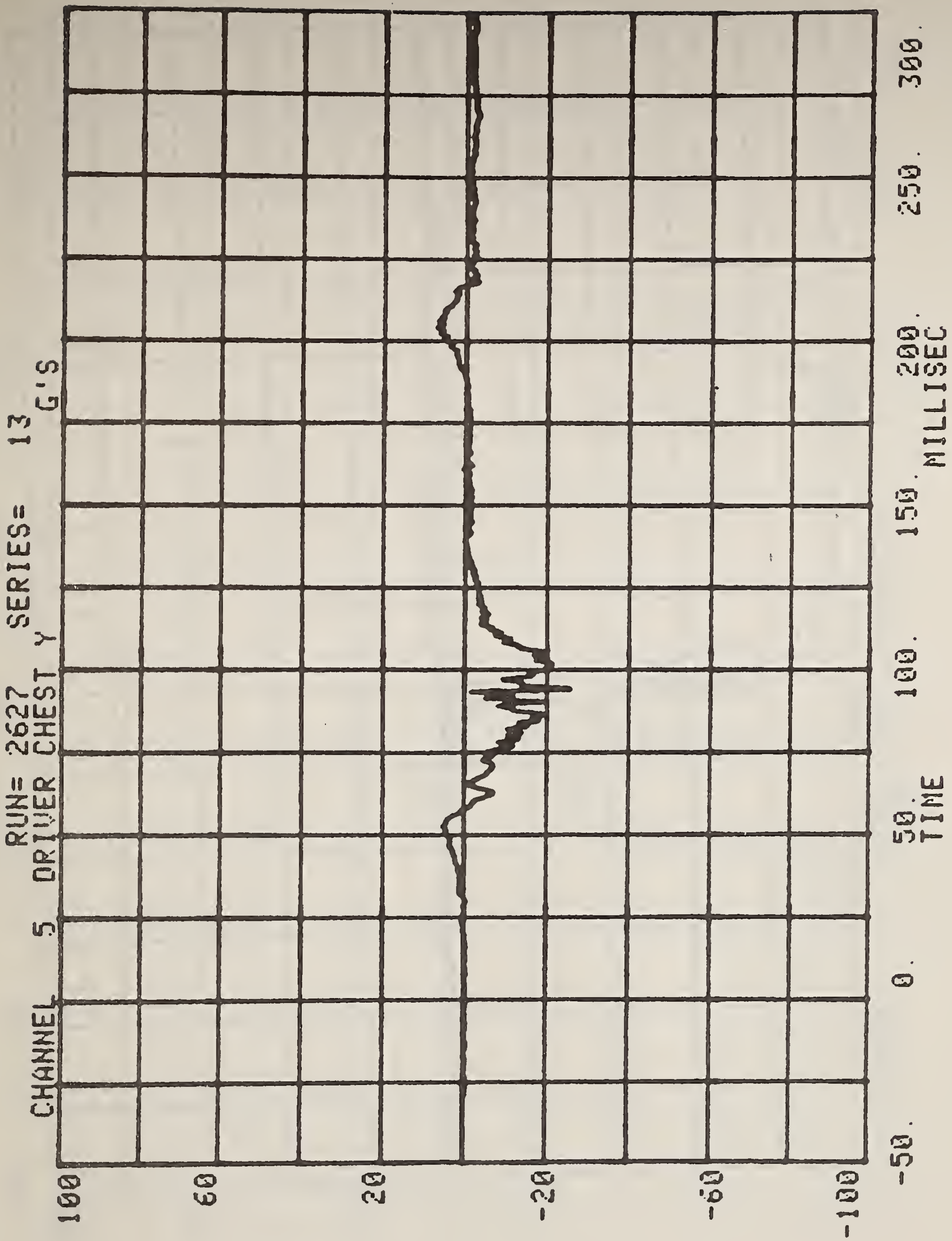

CHANNEL 2 RUN= 2627 SERIES= 13
DRIVER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

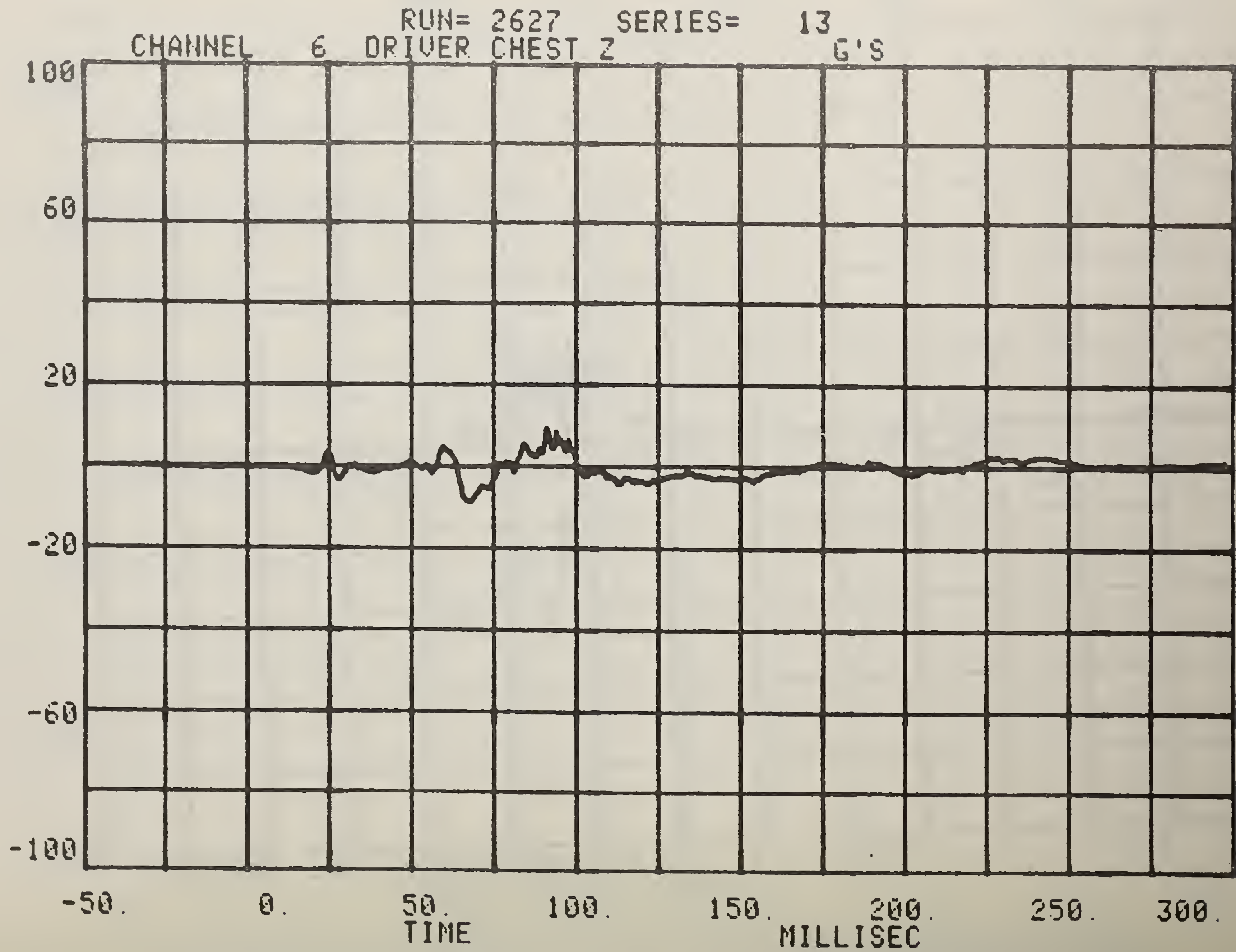

RUN= 2627 SERIES= 13
CHANNEL 3 DRIVER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

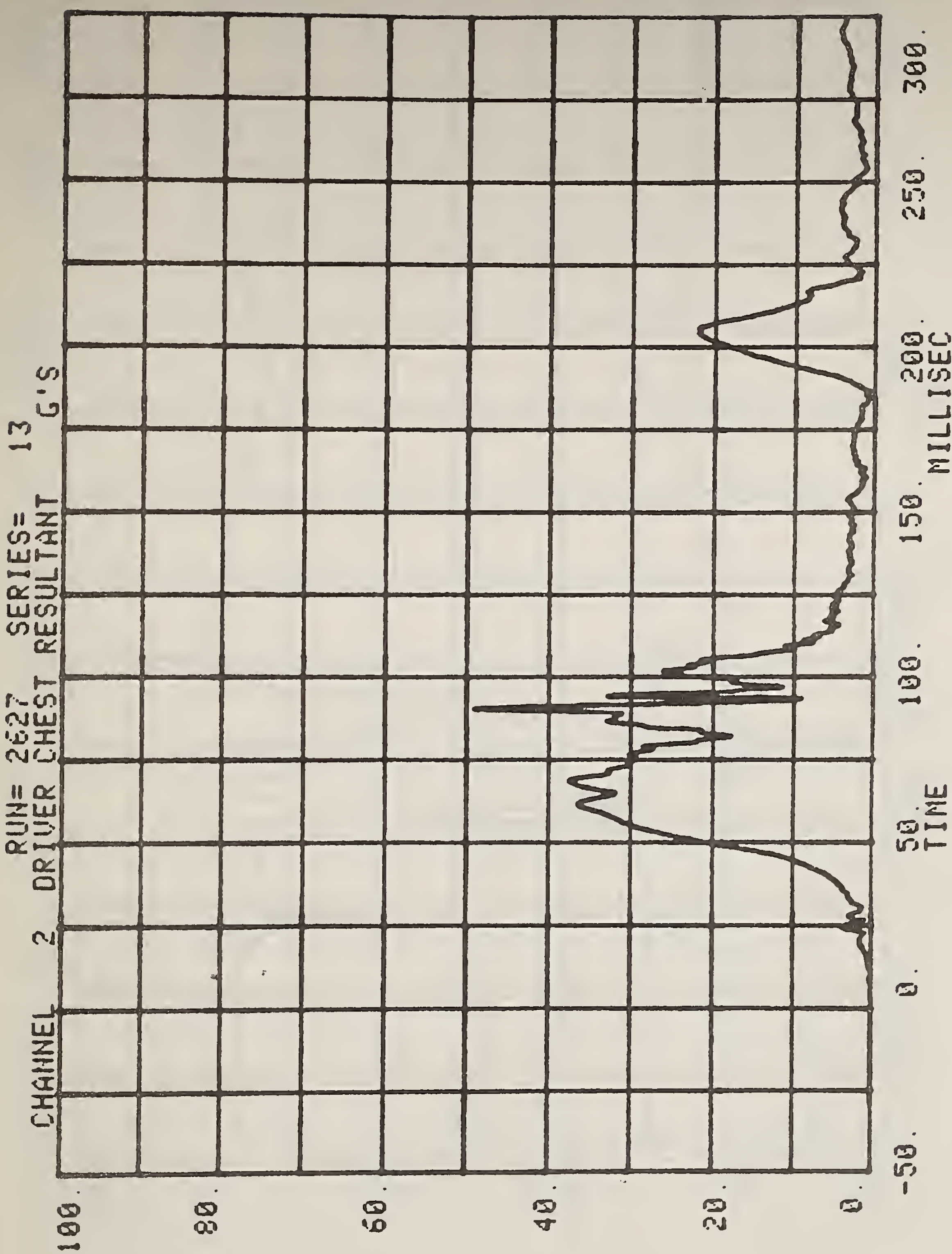


CHANNEL 1 RUN= 2627 SERIES= 13
DRIVER HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

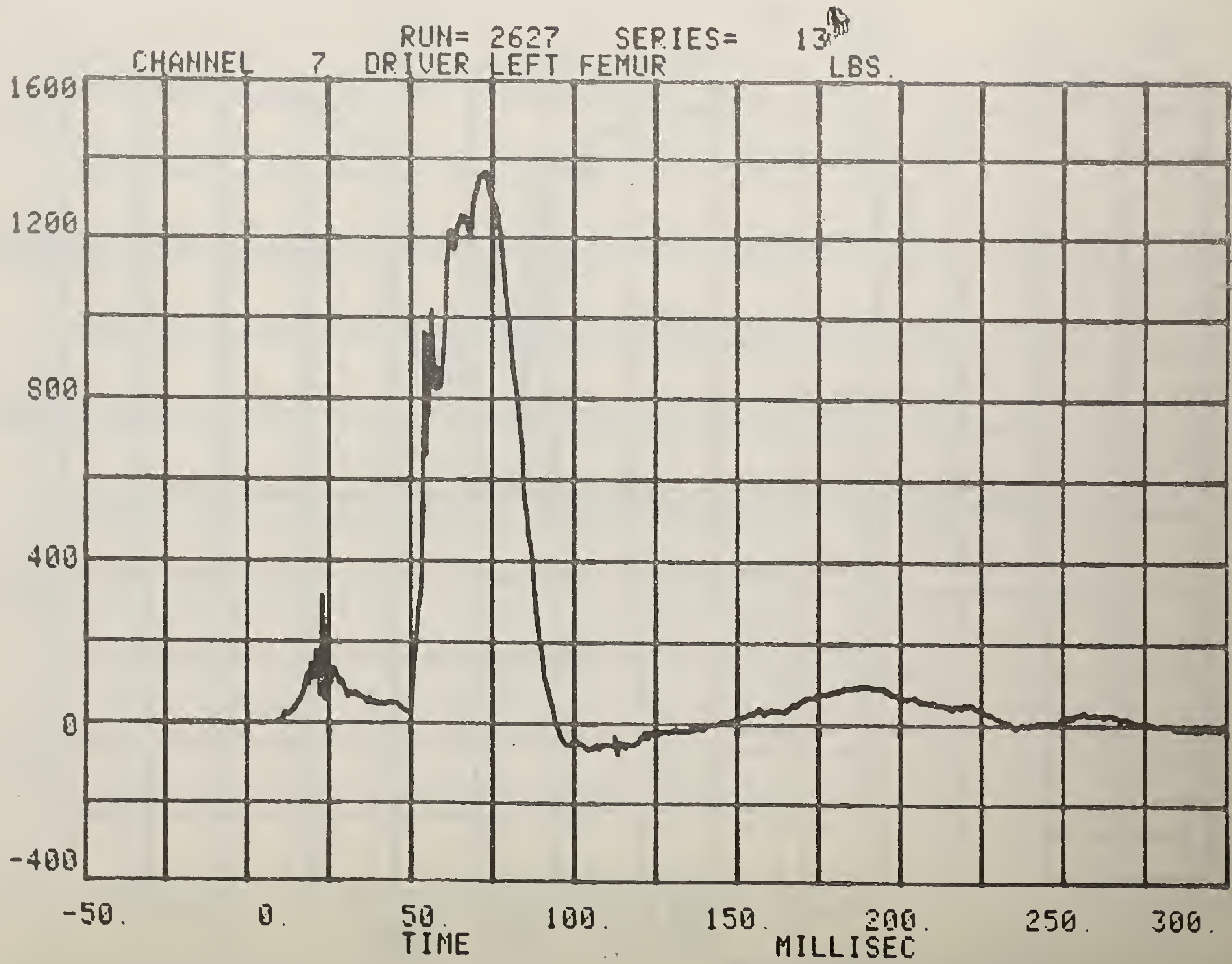

CHANNEL 4 RUN= 2627 SERIES= 13
DRIVER CHEST X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 5 RUN= 2627 SERIES= 13
DRIVER CHEST Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

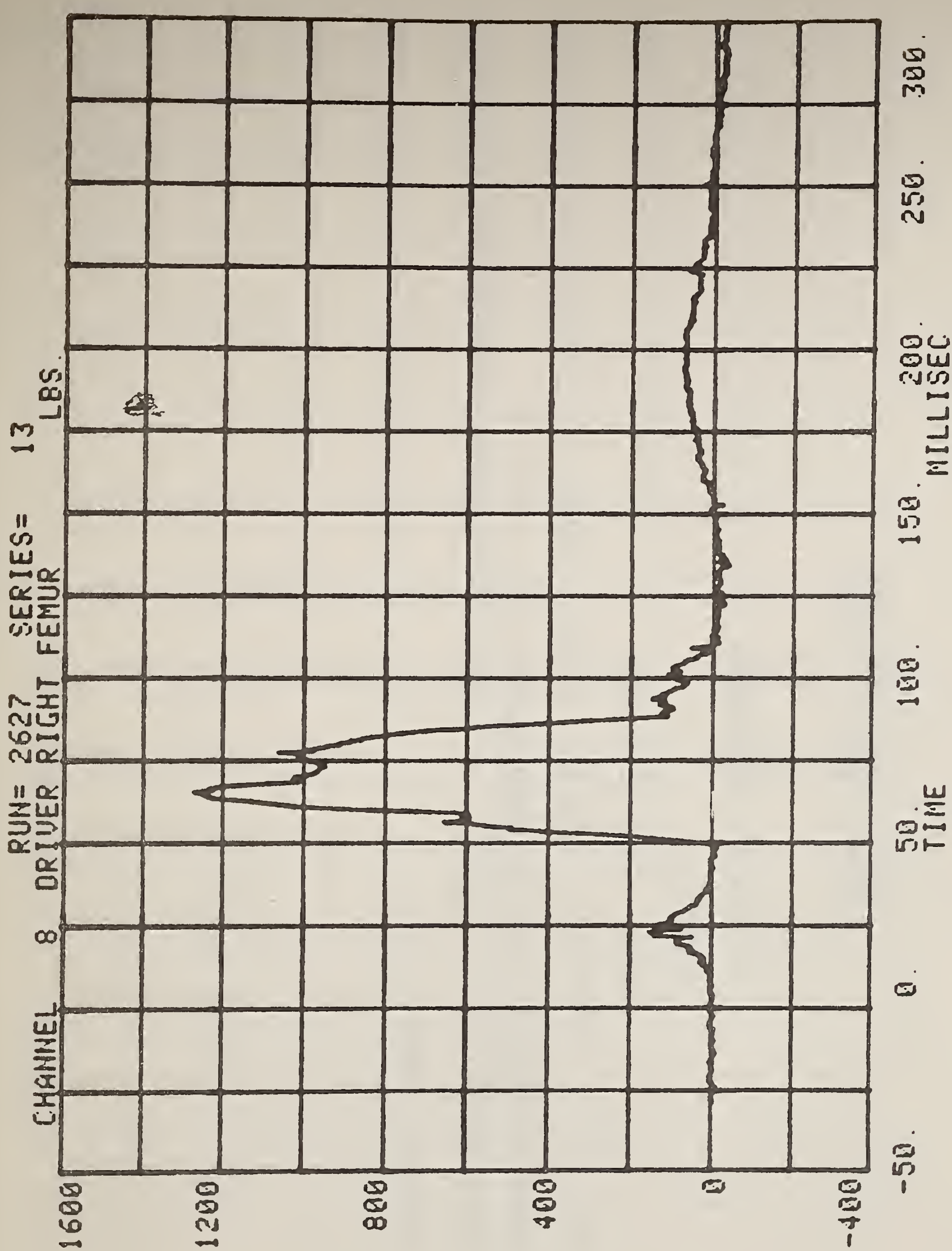

RUN= 2627 SERIES= 13
CHANNEL 6 DRIVER CHEST Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC



CHANNEL 2 RUN= 2627 SERIES= 13
DRIVER CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC



RUN= 2627 SERIES= 13
CHANNEL 7 DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 8 RUN= 2627 SERIES= 13
DRIVER RIGHT FEMUR
LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2627

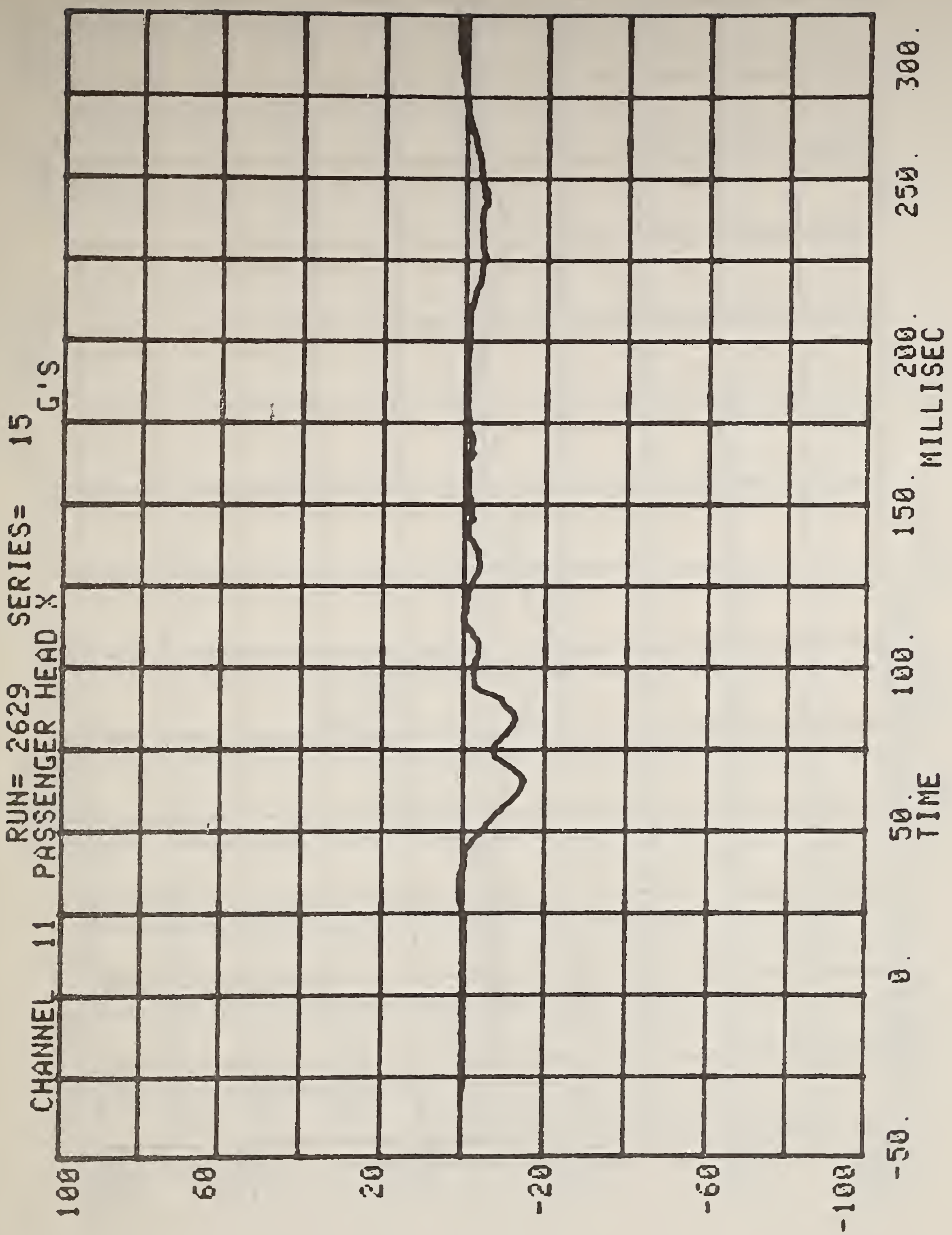
PASS. HEAD RESULTANT

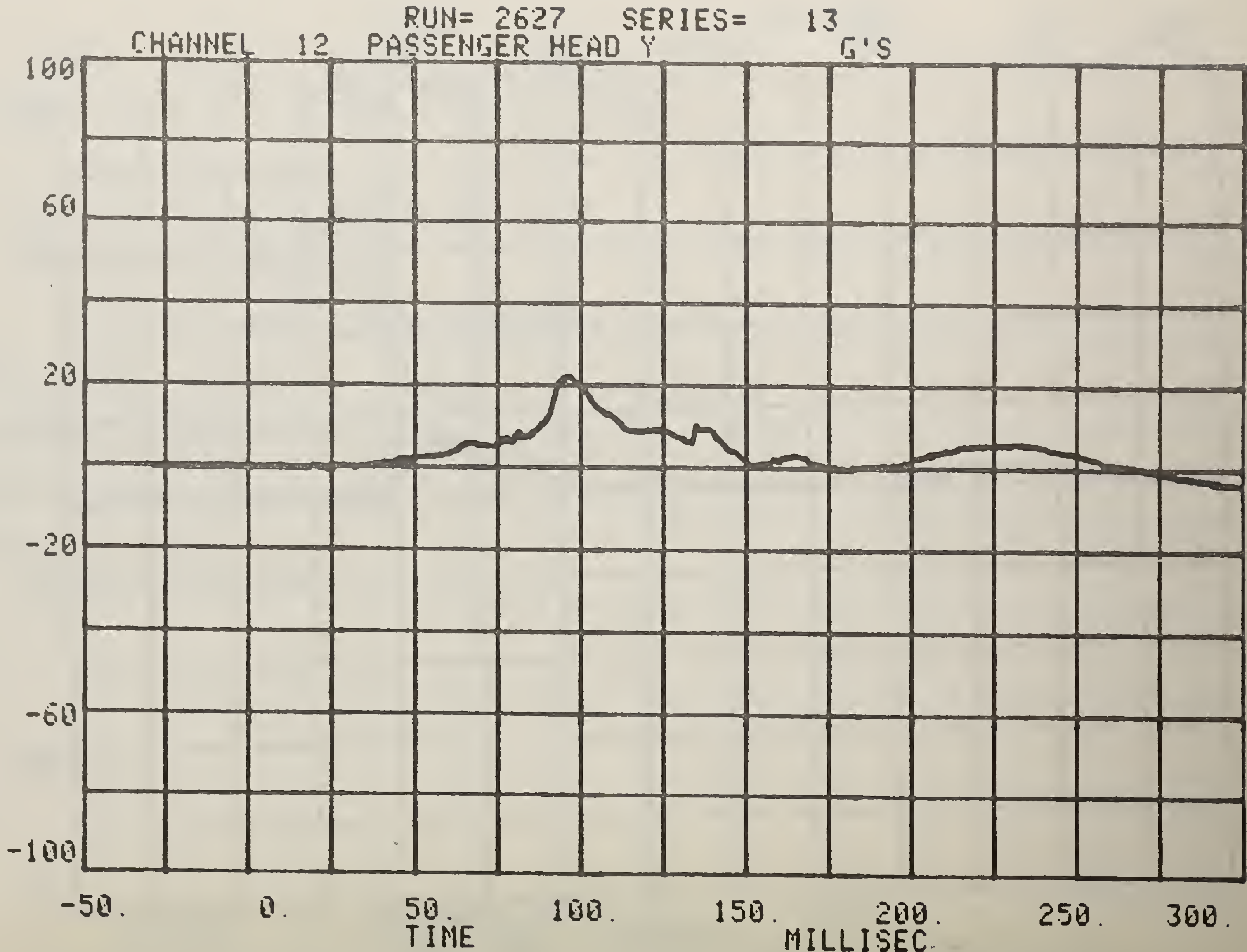
HIC= 178.7   FROM T1= .06060   TO T2= .10740

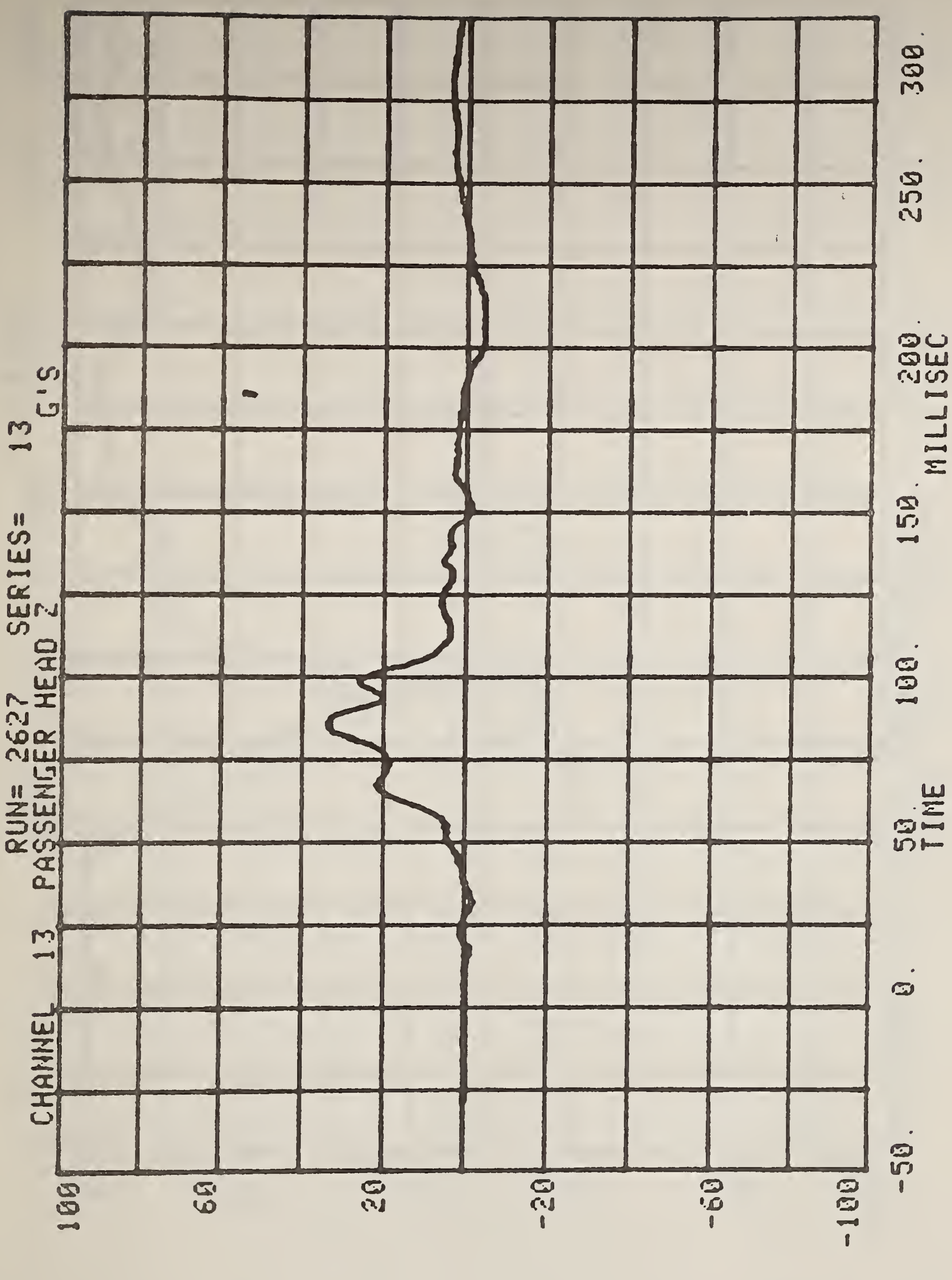
AVERAGE ACCELERATION BETWEEN T1 AND T2= 27.1G'S

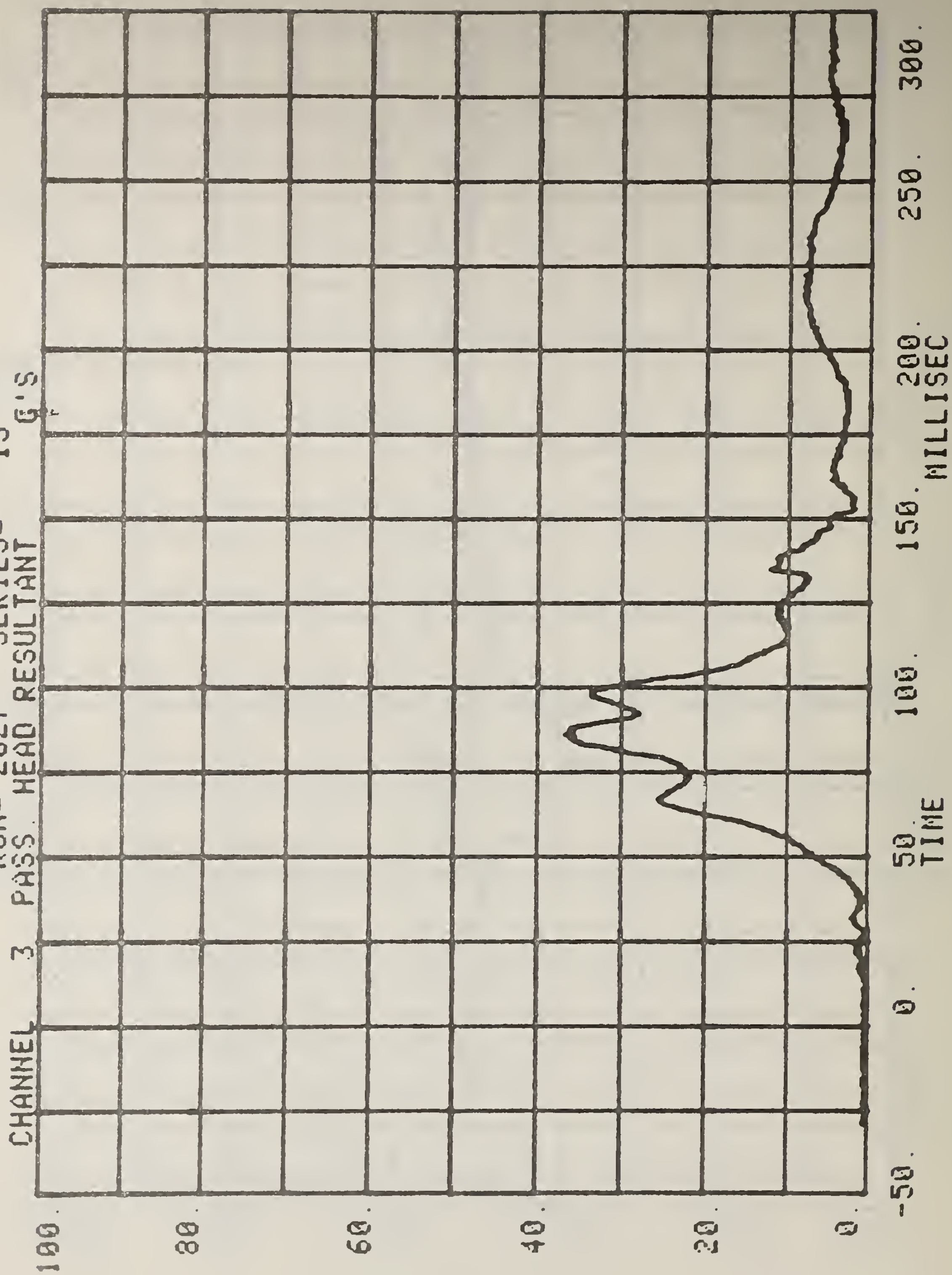
EVENT TIME= 300.0 MSEC

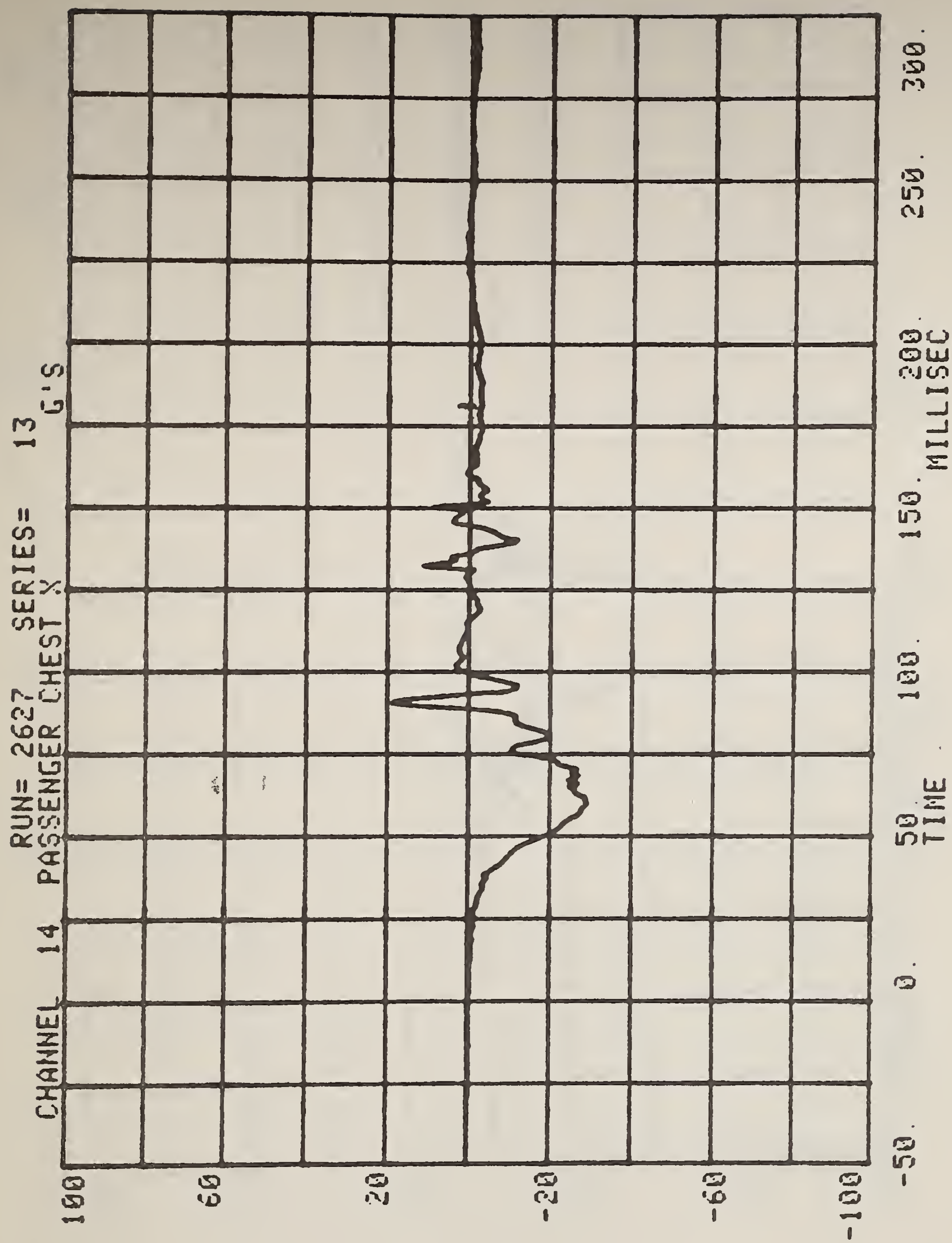
SEVERITY INDEX= 221.9


CHANNEL 11 RUN= 2629 SERIES= 15
PASSENGER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

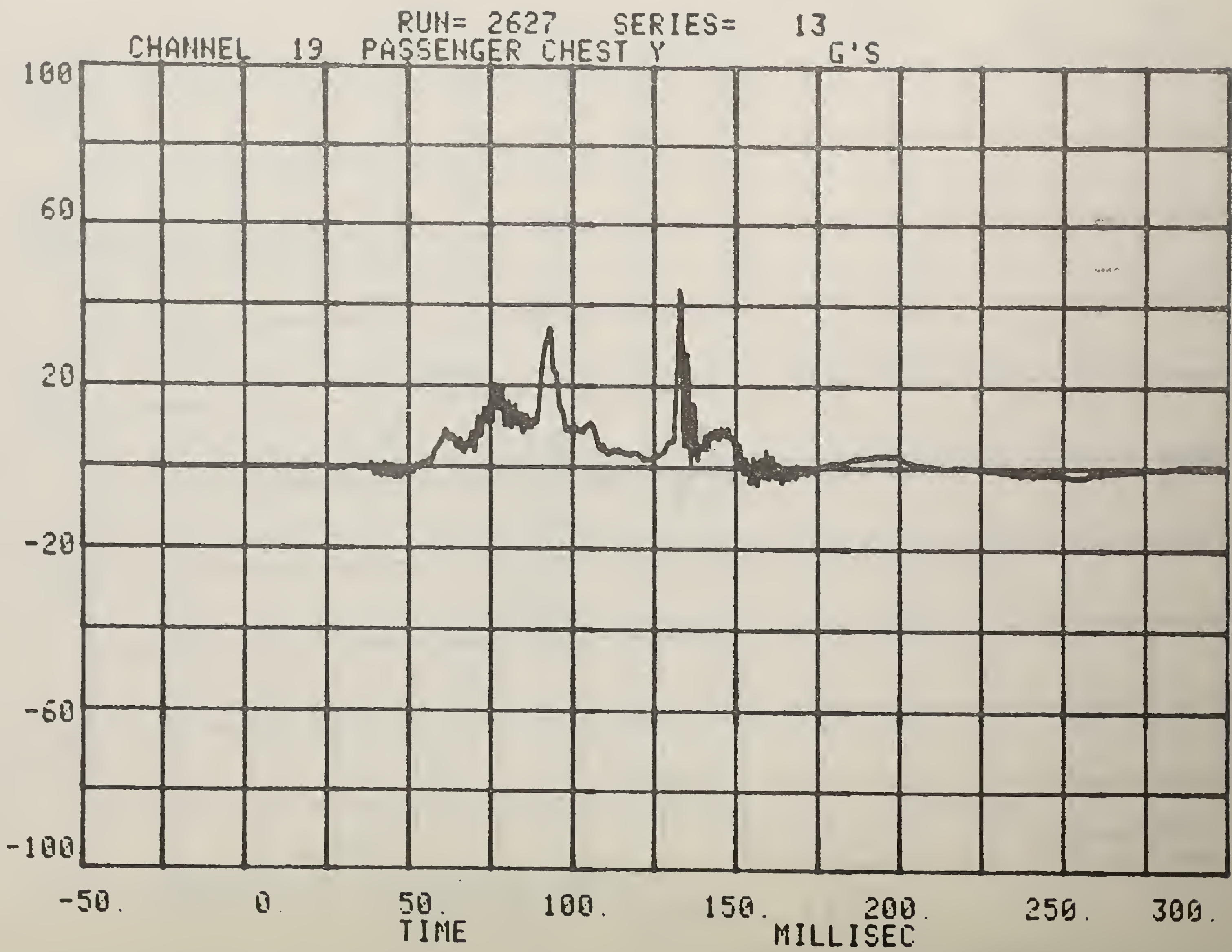

RUN= 2627 SERIES= 13
CHANNEL 12 PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

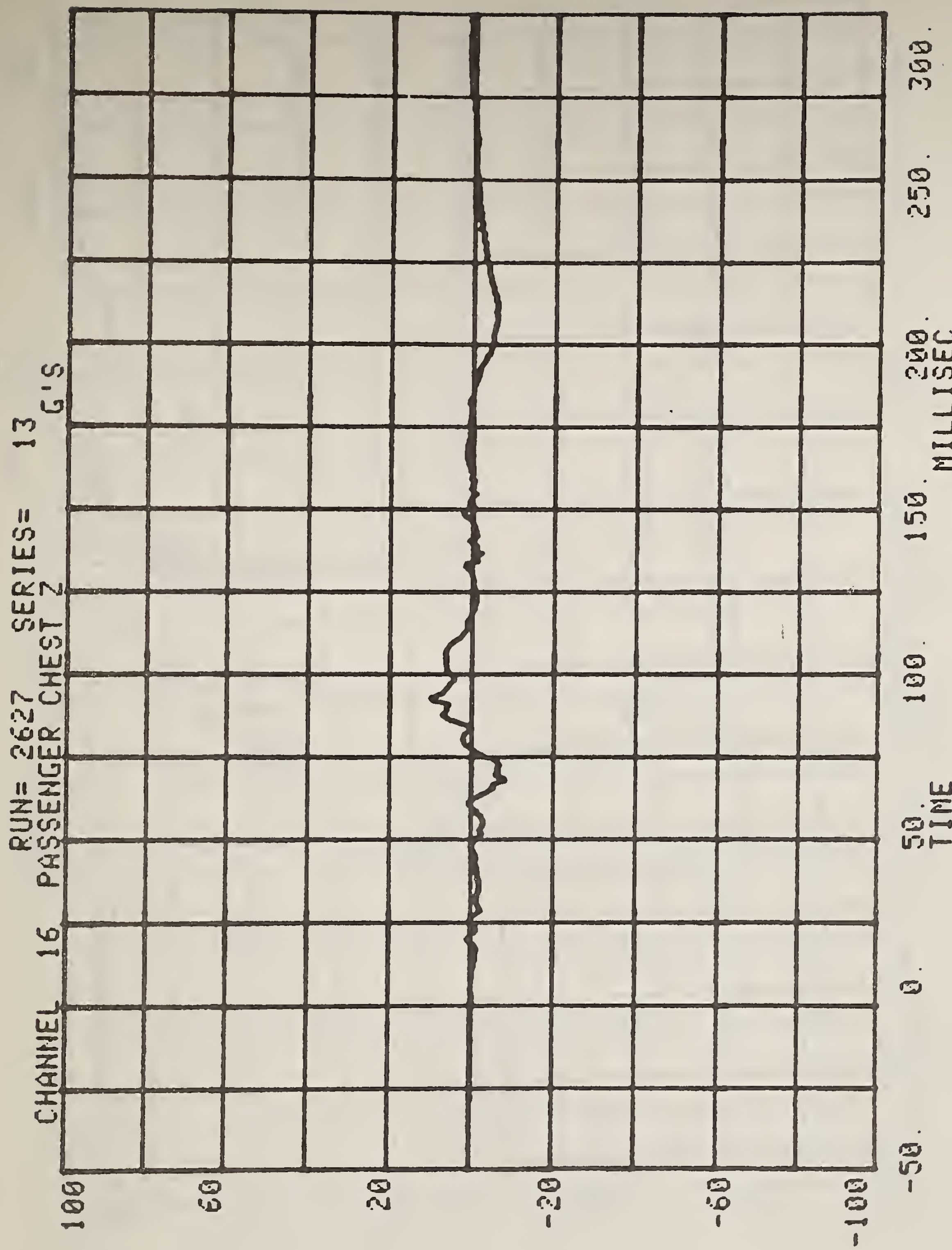

CHANNEL 13 RUN= 2627 SERIES= 13
PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

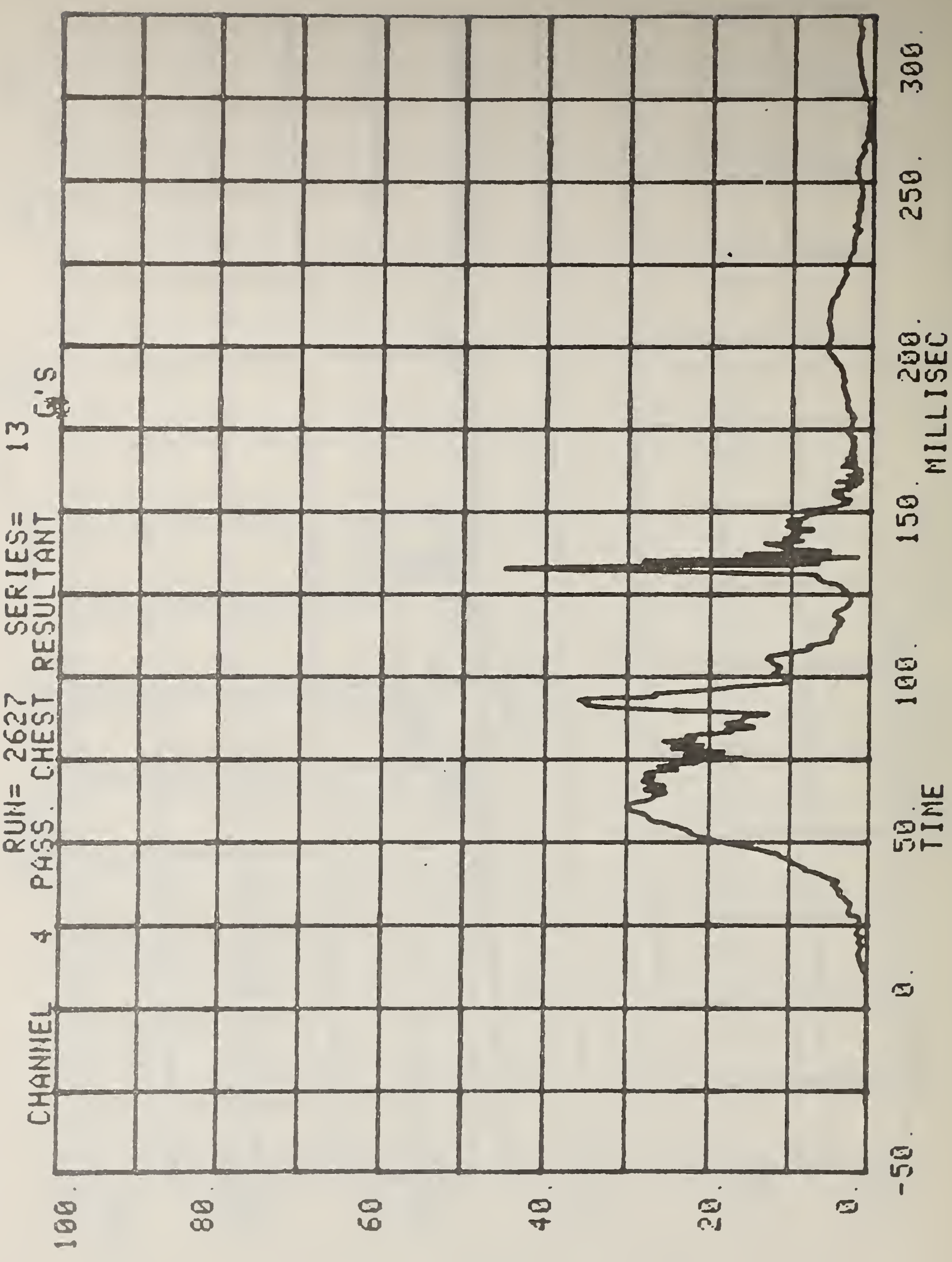

CHANNEL 3 RUN= 2627 SERIES= 13
PASS. HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

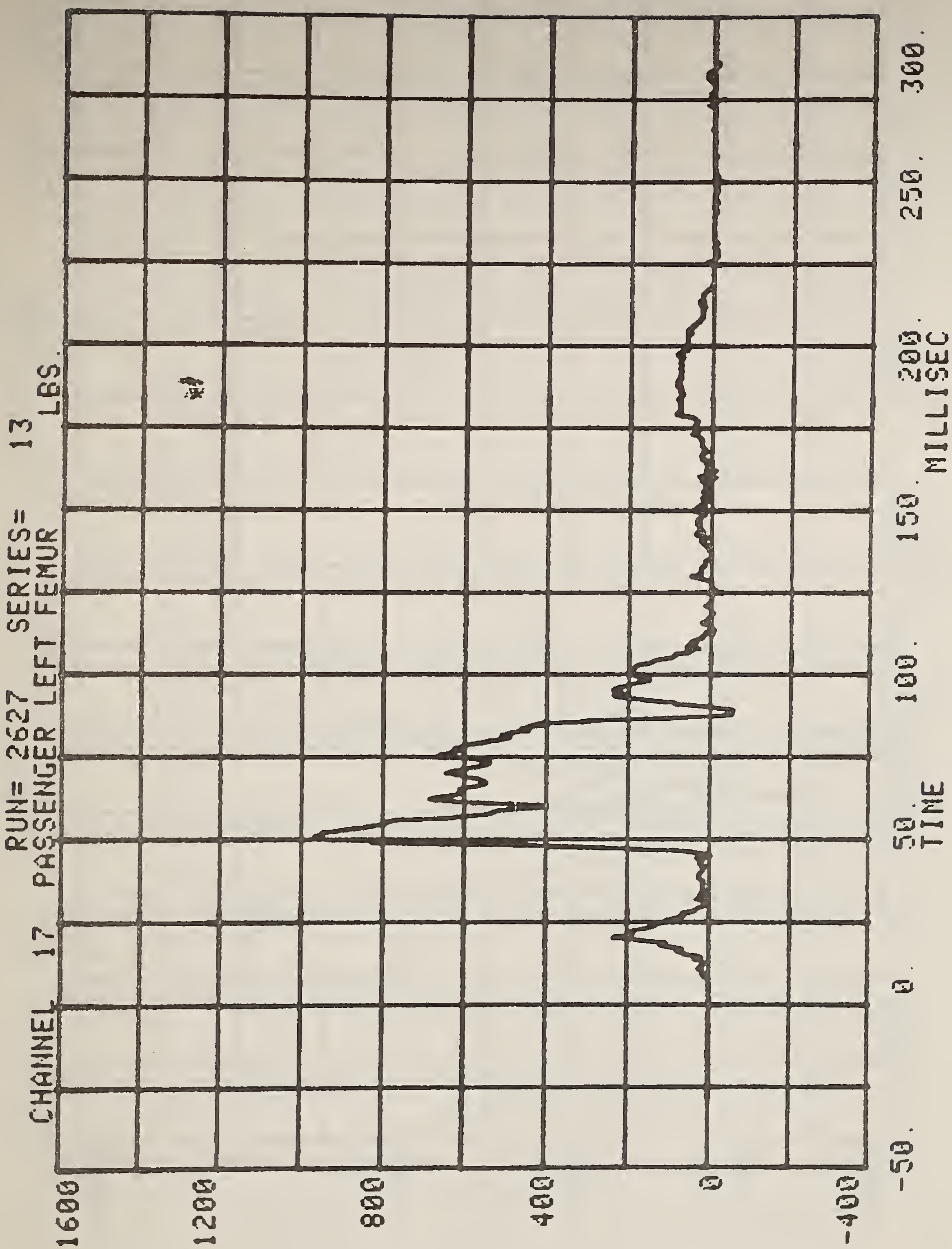


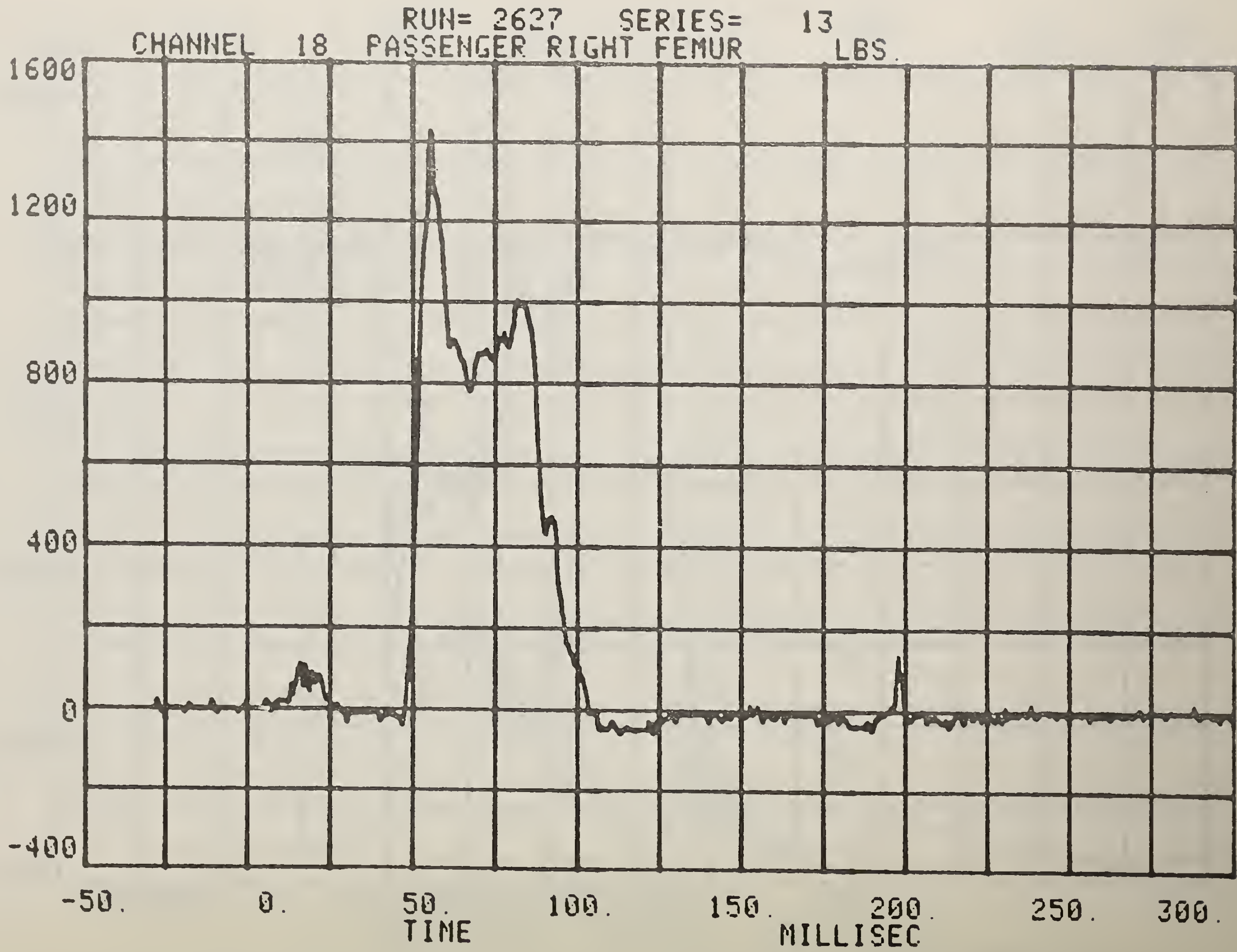
CHANNEL 14 RUN= 2627 SERIES= 13
PASSENGER CHEST X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

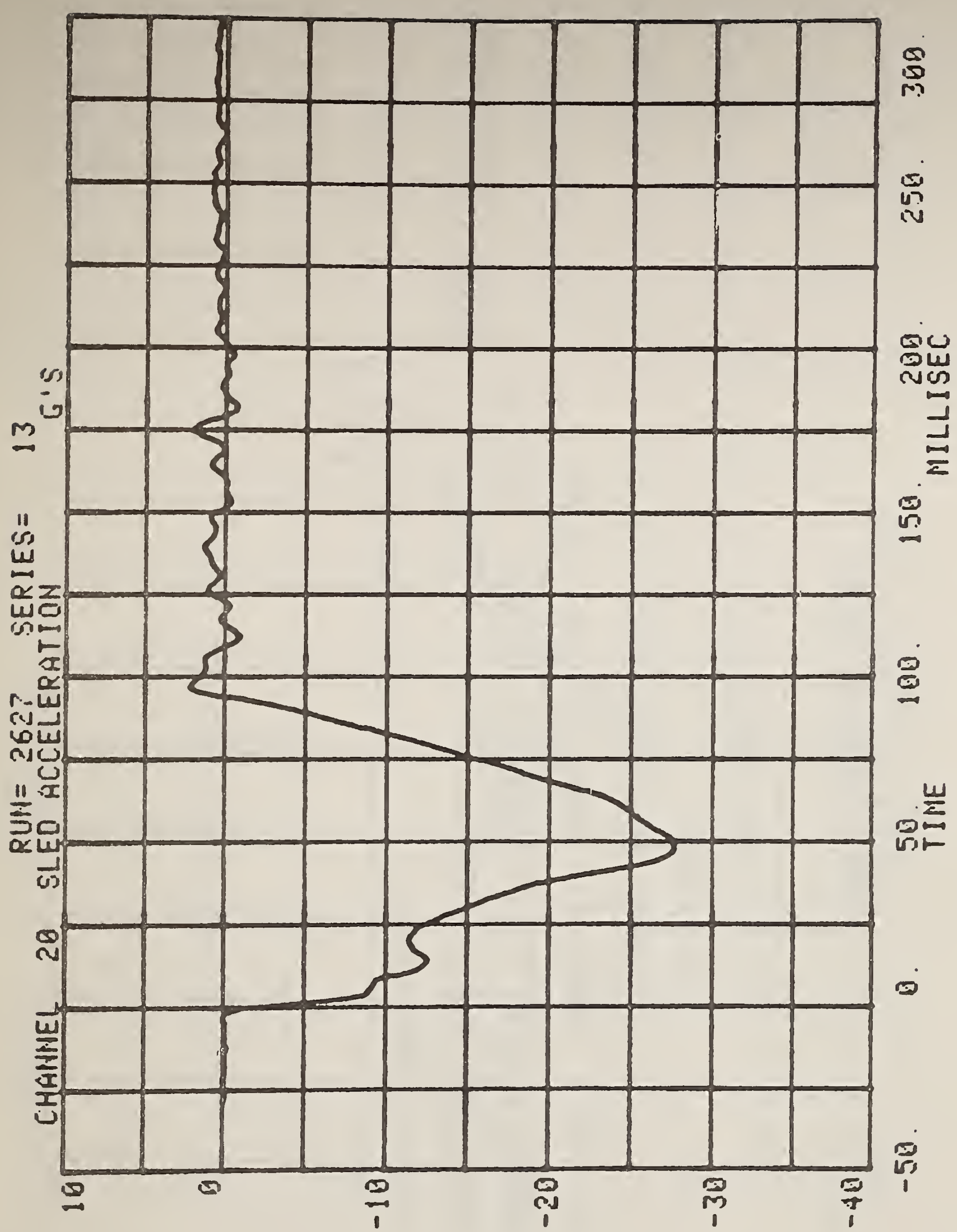

RUN= 2627 SERIES= 13
CHANNEL 19 PASSENGER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 16 RUN= 2627 SERIES= 13
PASSENGER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 4 RUN= 2627 SERIES= 13
PASS. CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 17 RUN= 2627 SERIES= 13
PASSENGER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2627 SERIES= 13
CHANNEL 18 PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 20 RUN= 2627 SERIES= 13
SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2628

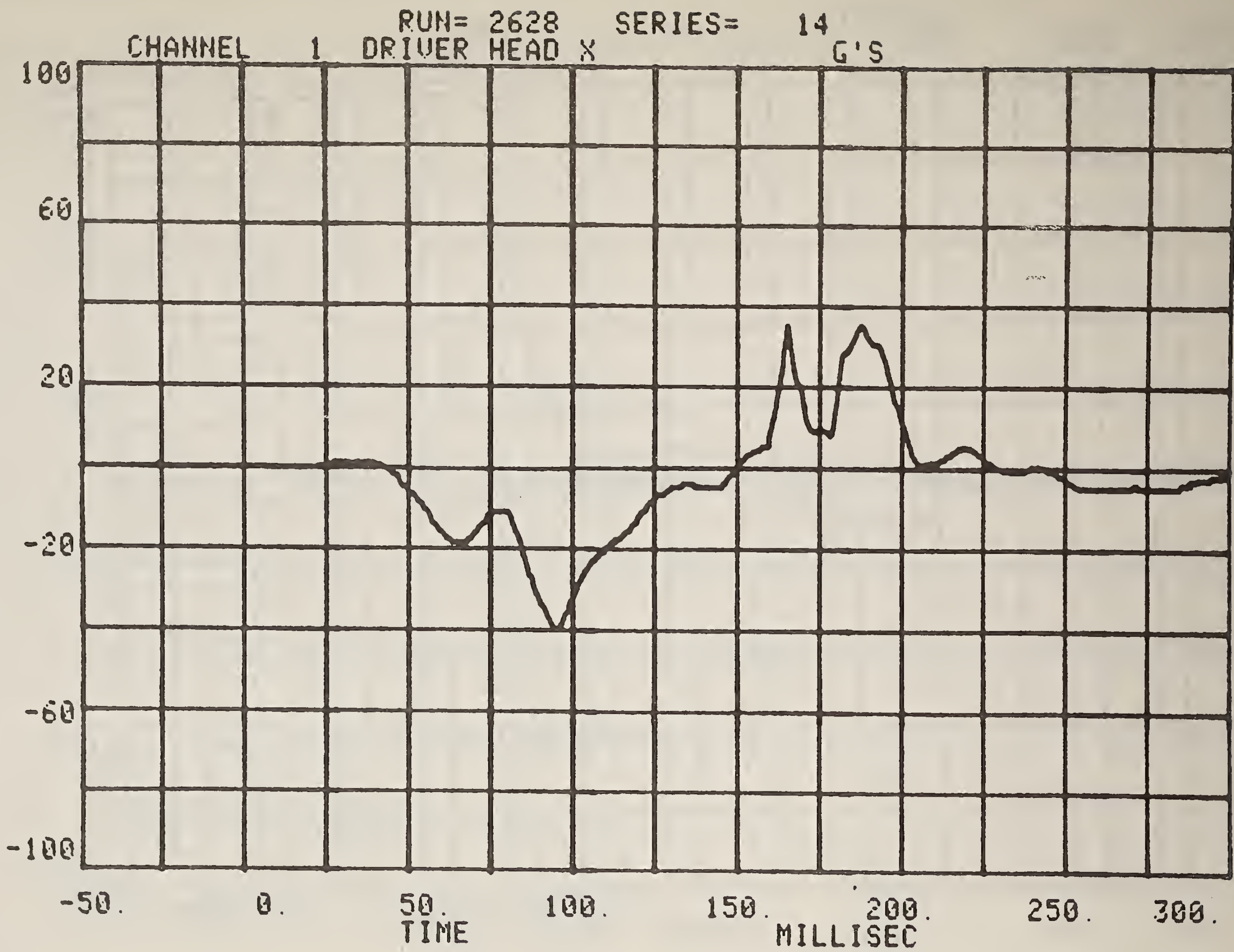
DRIVER HEAD RESULTANT

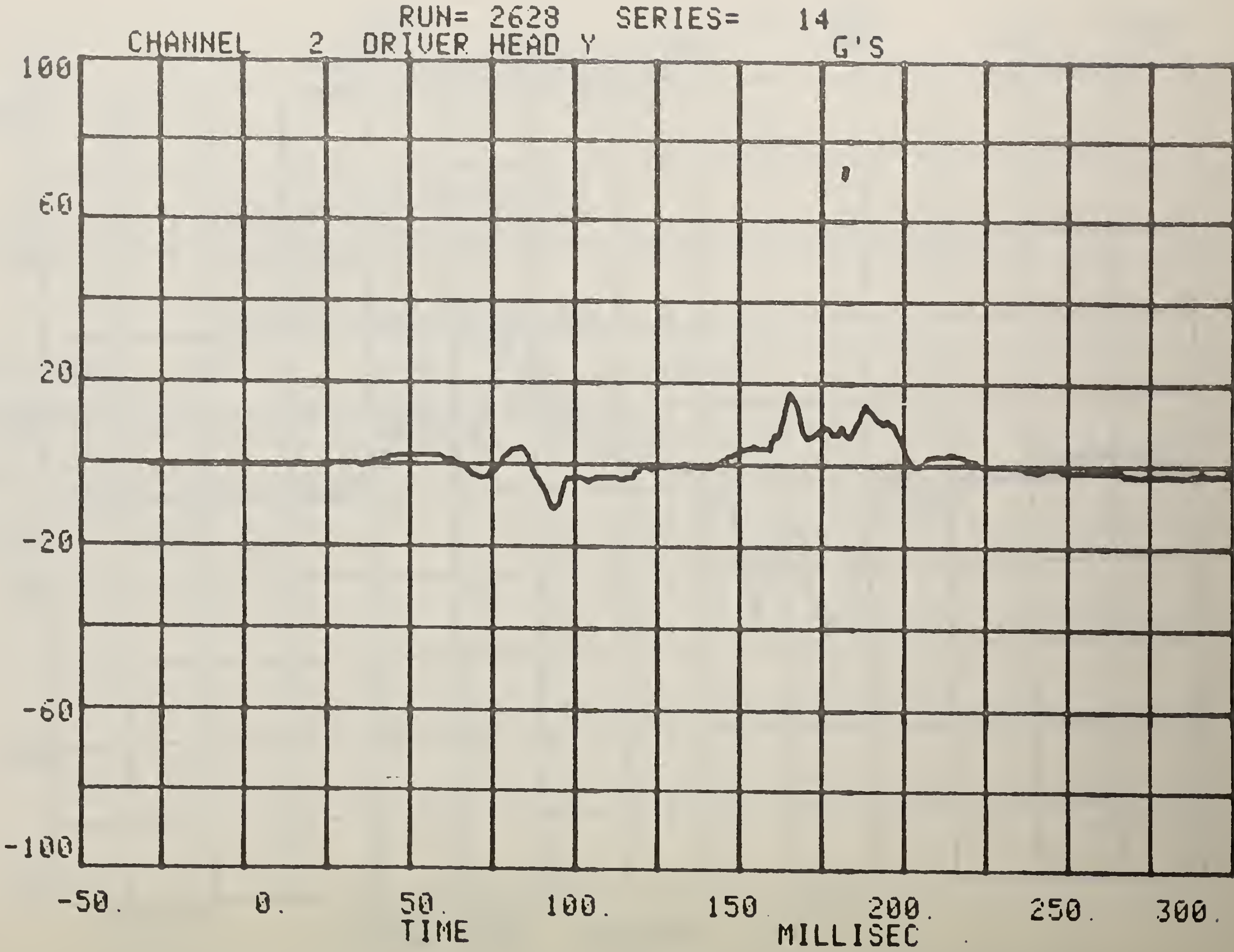
HIC= 555.2 FROM T1= .06090 TO T2= .10800

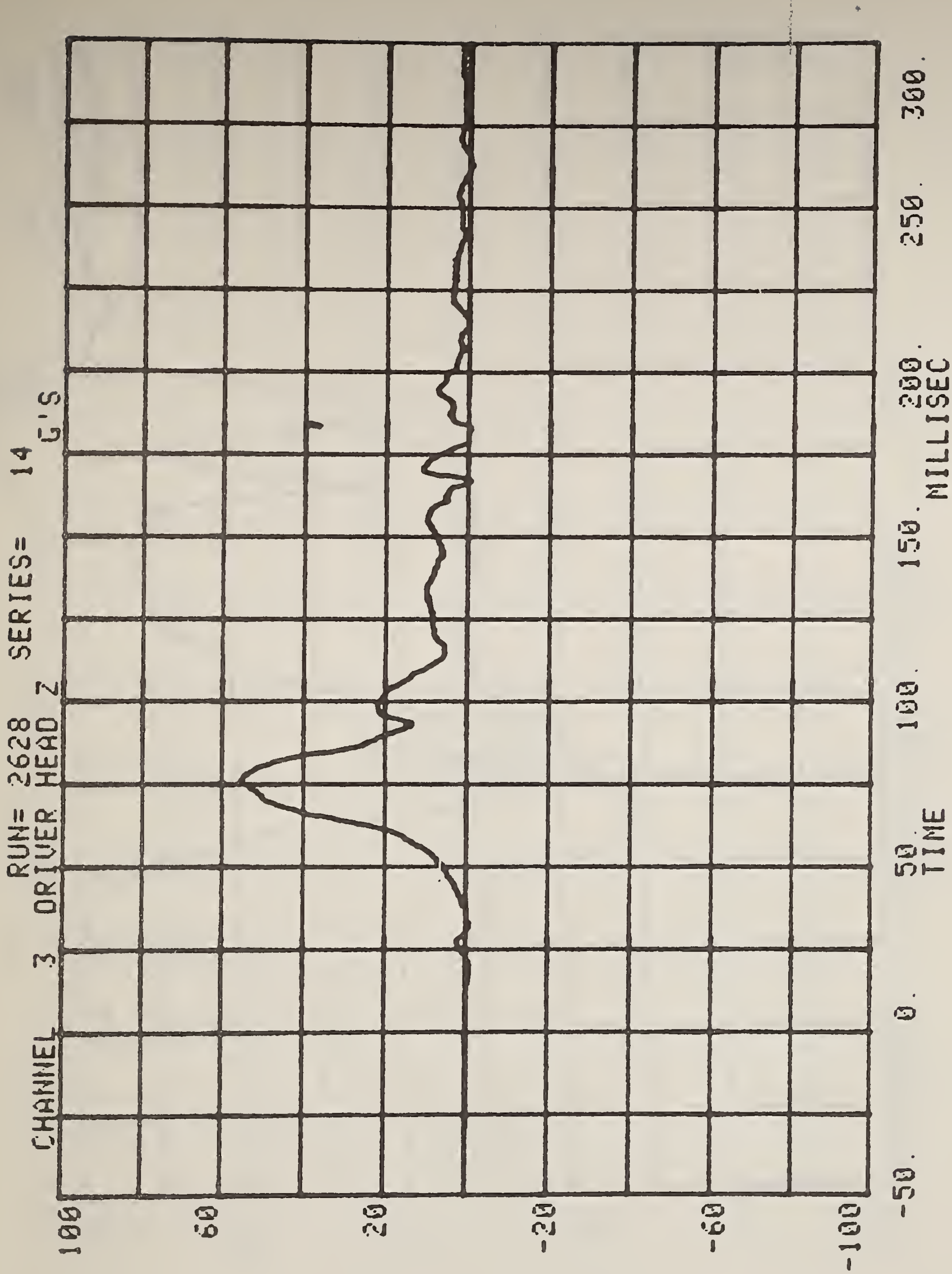
AVERAGE ACCELERATION BETWEEN T1 AND T2= 42.5G'S

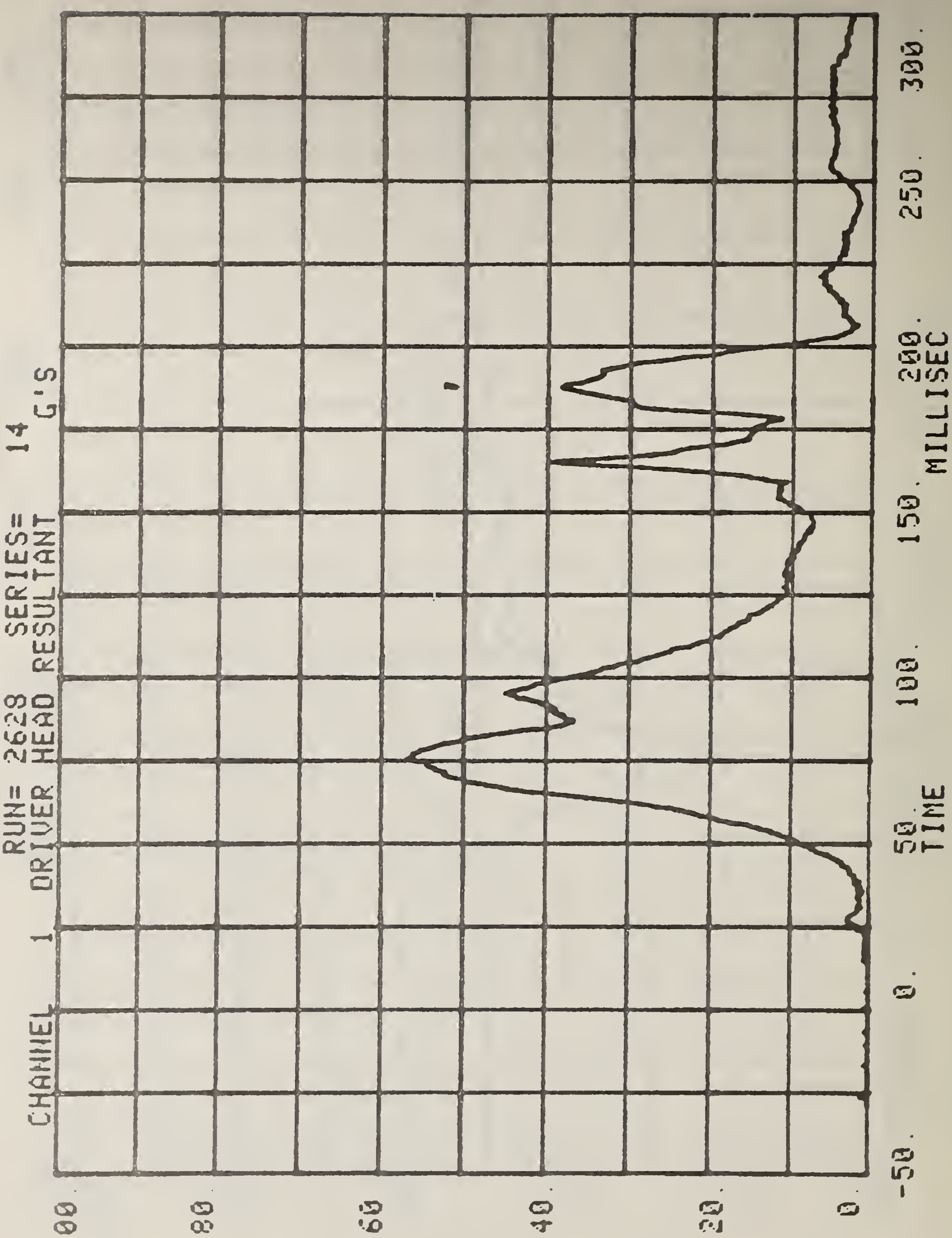
EVENT TIME= 300.0 MSEC

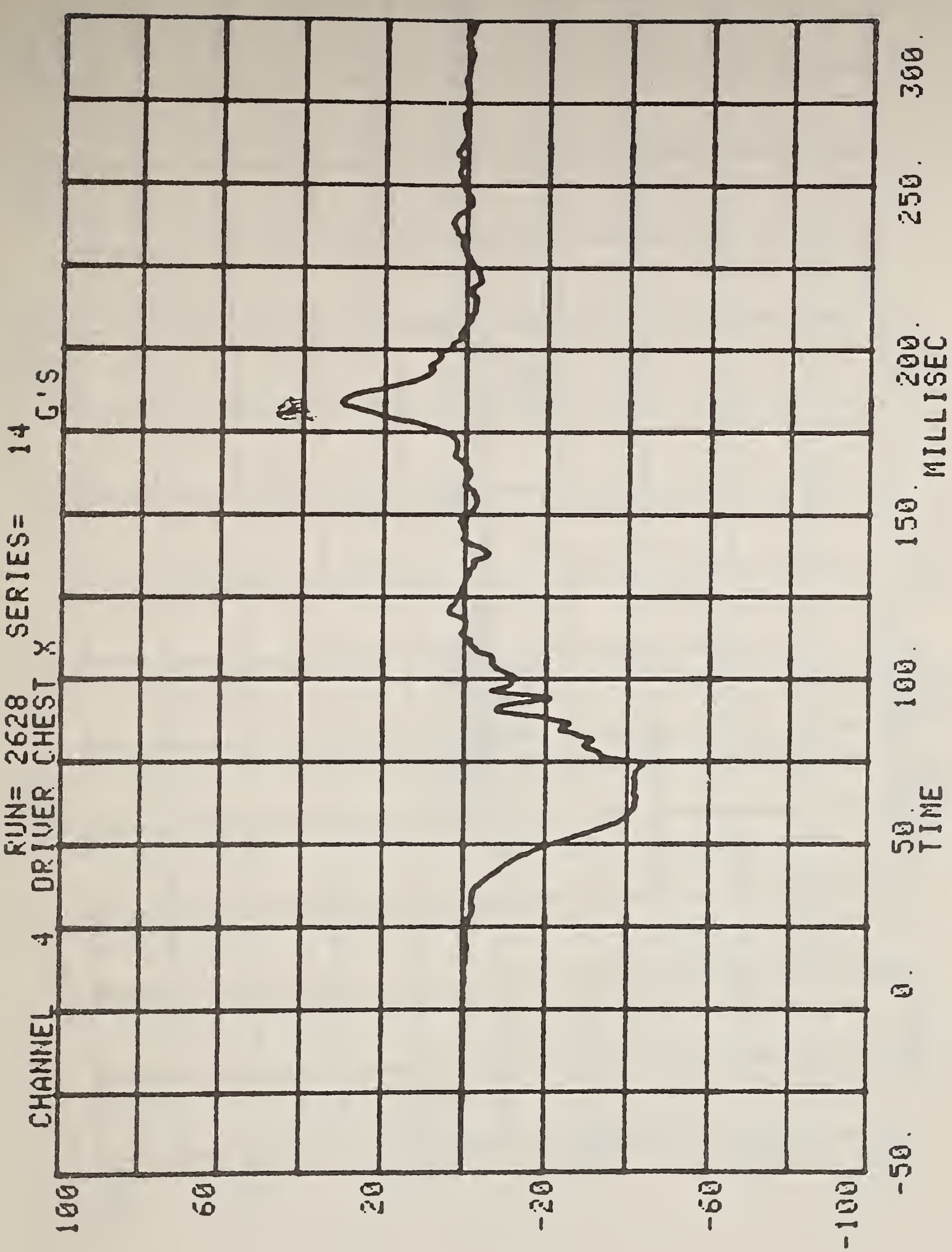
SEVERITY INDEX= 804.8

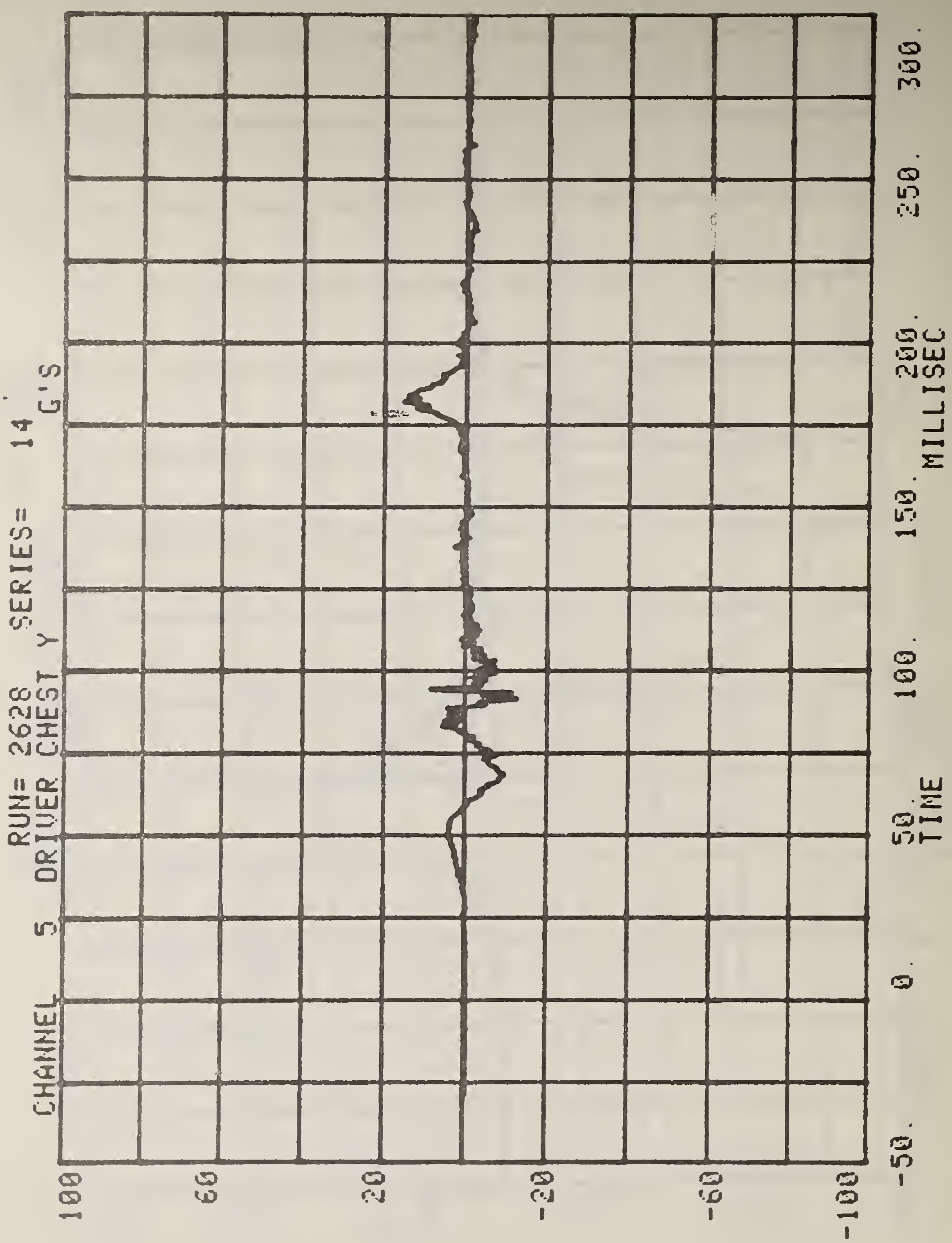

RUN= 2628 SERIES= 14
CHANNEL 1 DRIVER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

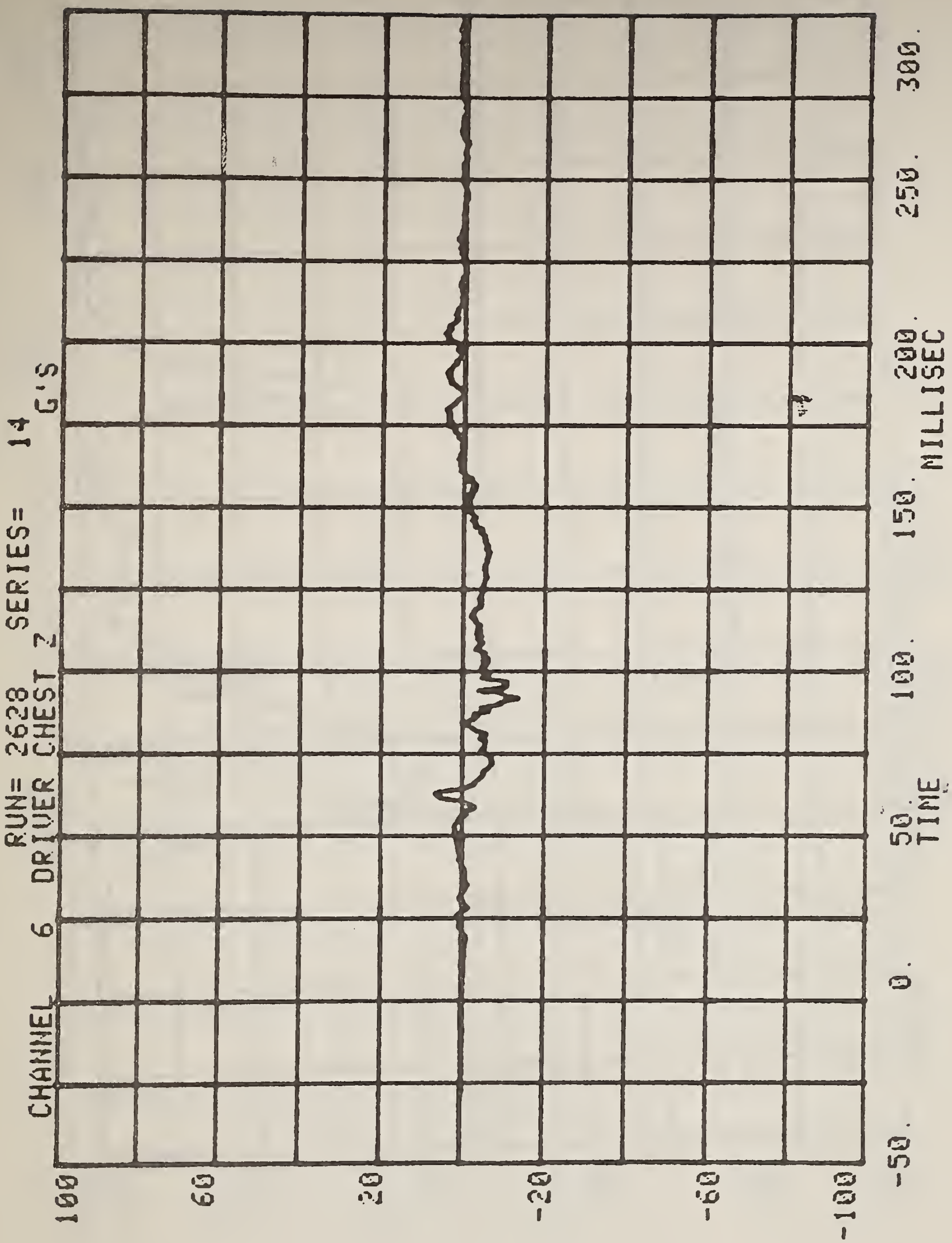

RUN= 2628 SERIES= 14
CHANNEL 2 DRIVER HEAD Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

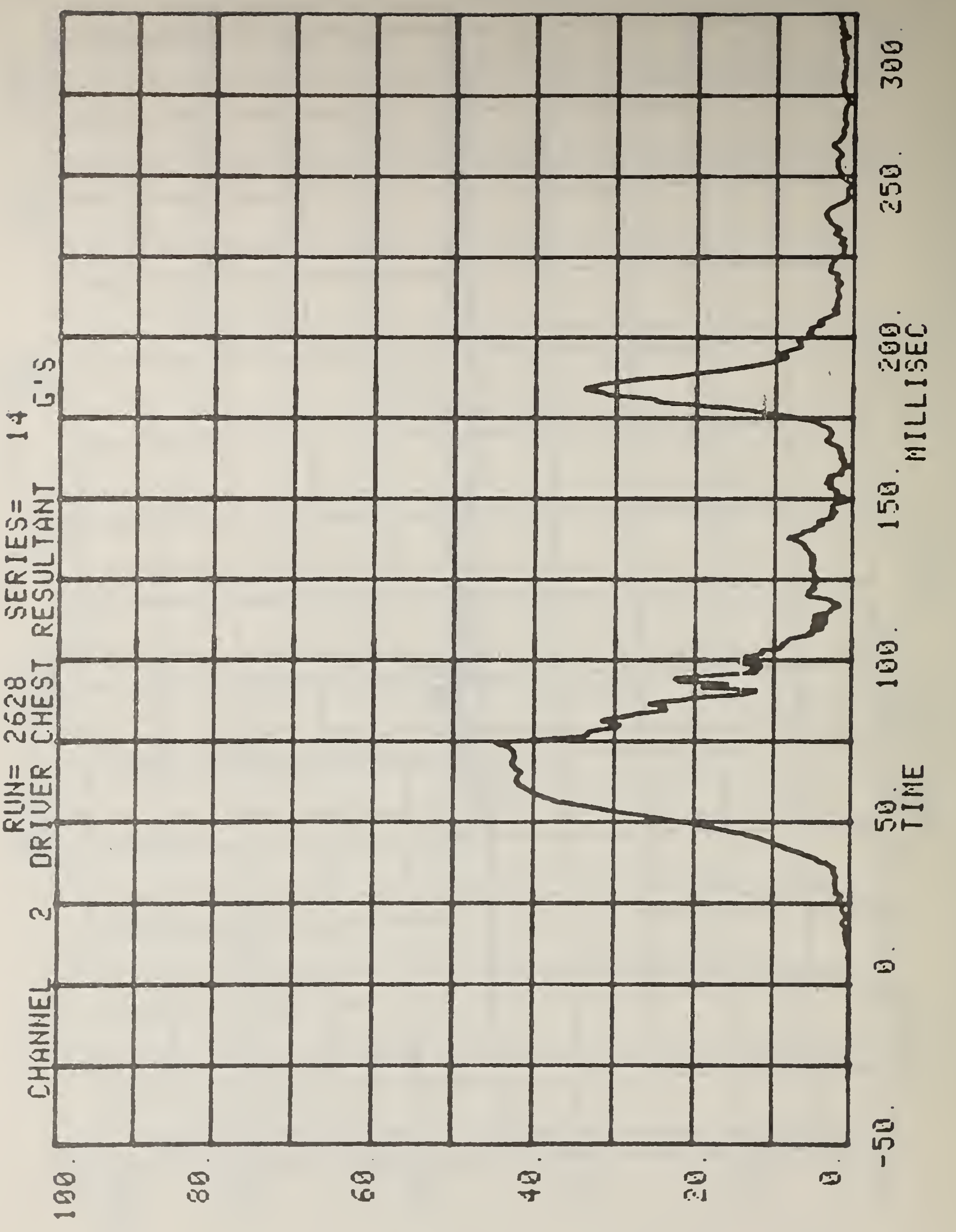

CHANNEL 3 RUN= 2628 SERIES= 14
DRIVER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

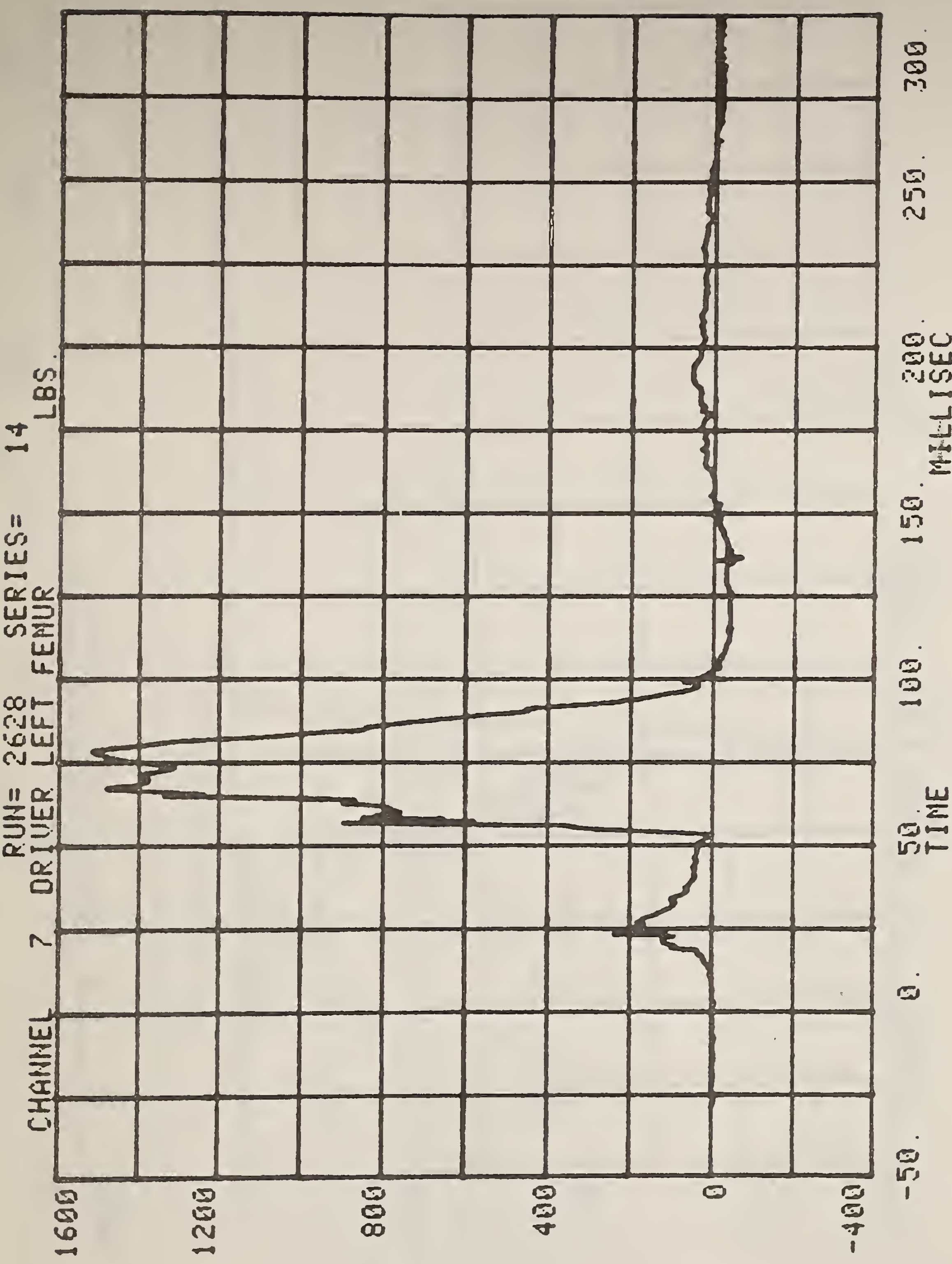

CHANNEL 1 RUN= 2628 SERIES= 14
DRIVER HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

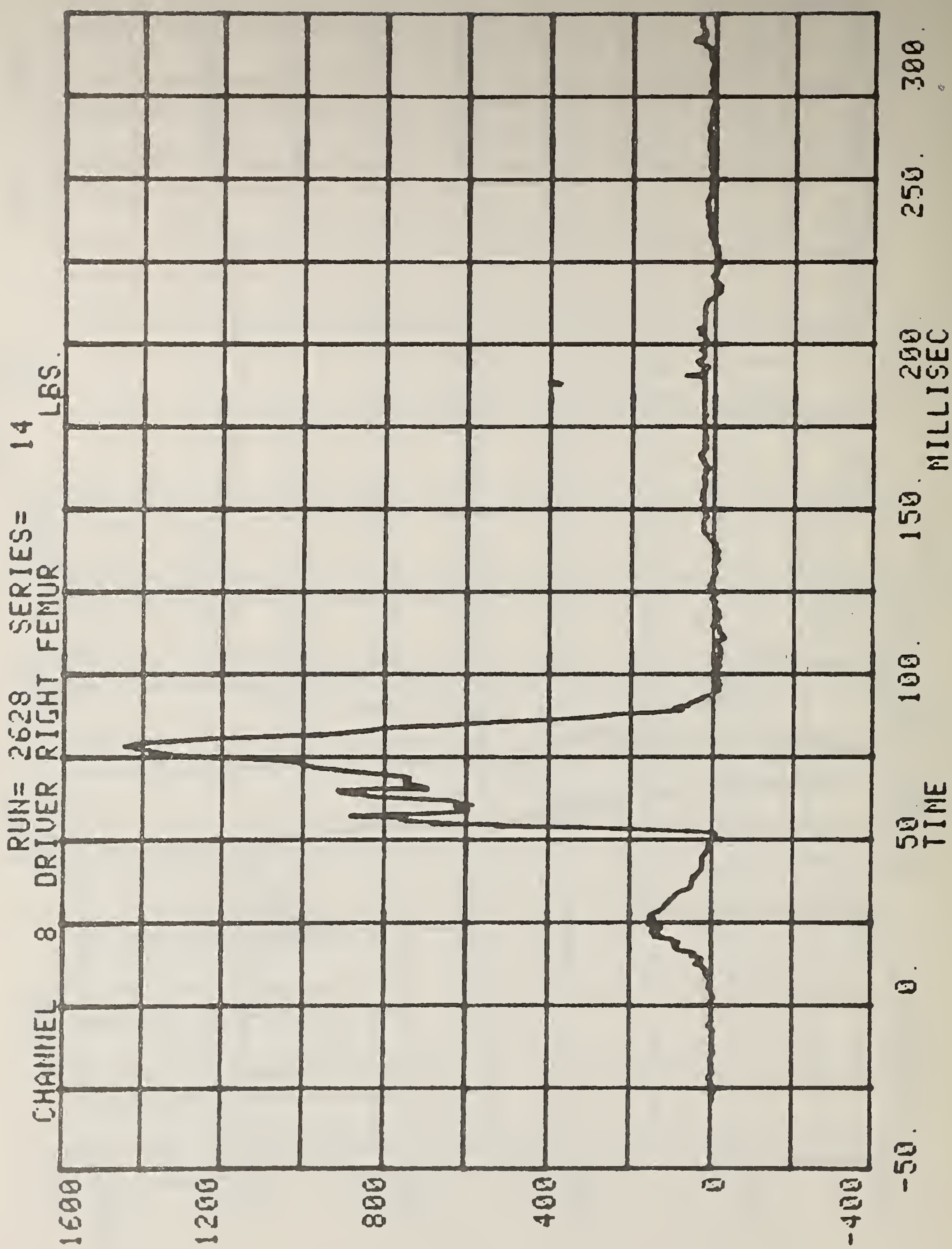

CHANNEL 4 RUN= 2628 SERIES= 14
DRIVER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 5 RUN= 2628 SERIES= 14
DRIVER CHEST Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 6 RUN= 2628 SERIES= 14
DRIVER CHEST Z G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 2 RUN= 2628 SERIES= 14
DRIVER CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 7 RUN= 2628 SERIES= 14
DRIVER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 8 RUN= 2628 SERIES= 14
DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2628

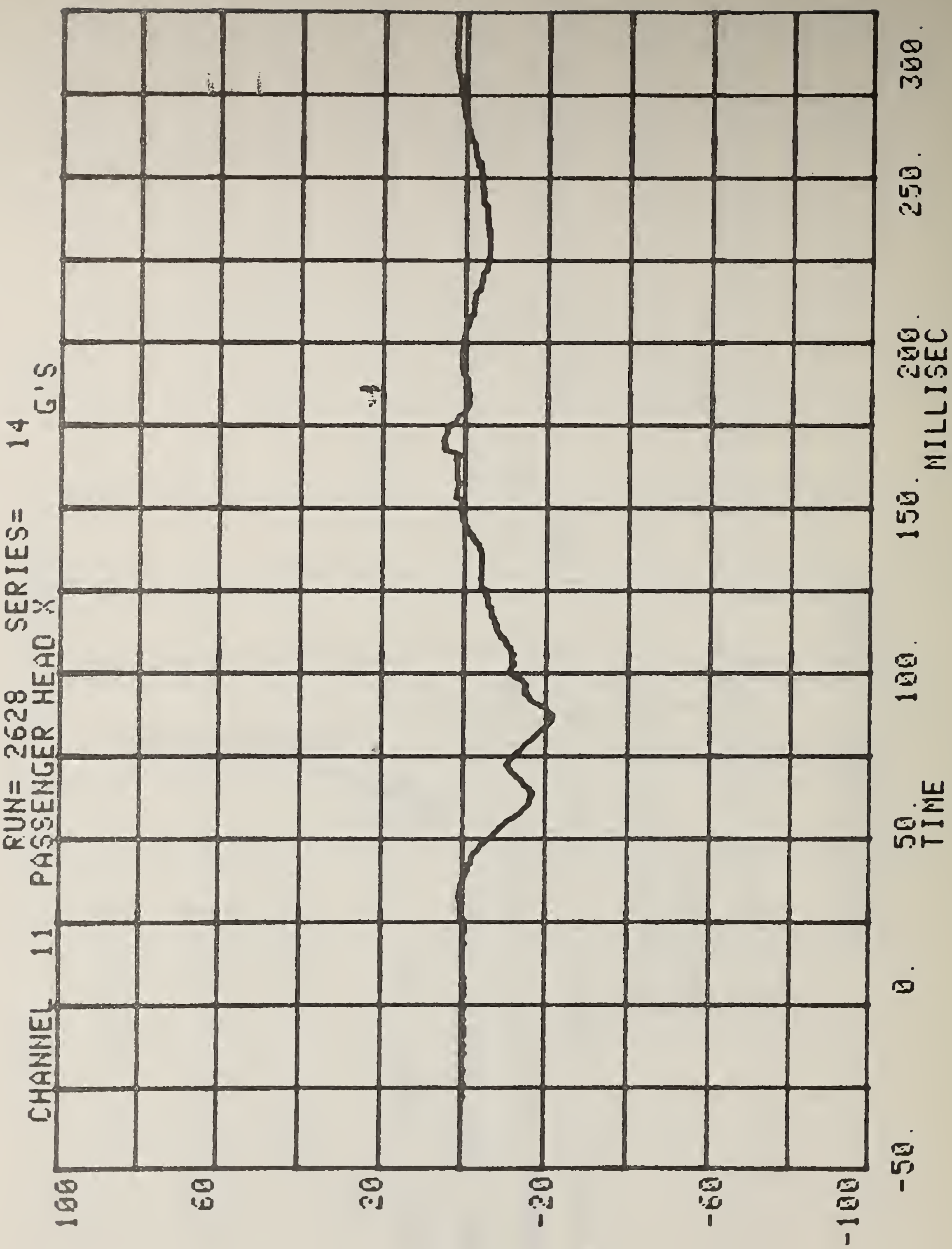
PASS. HEAD RESULTANT

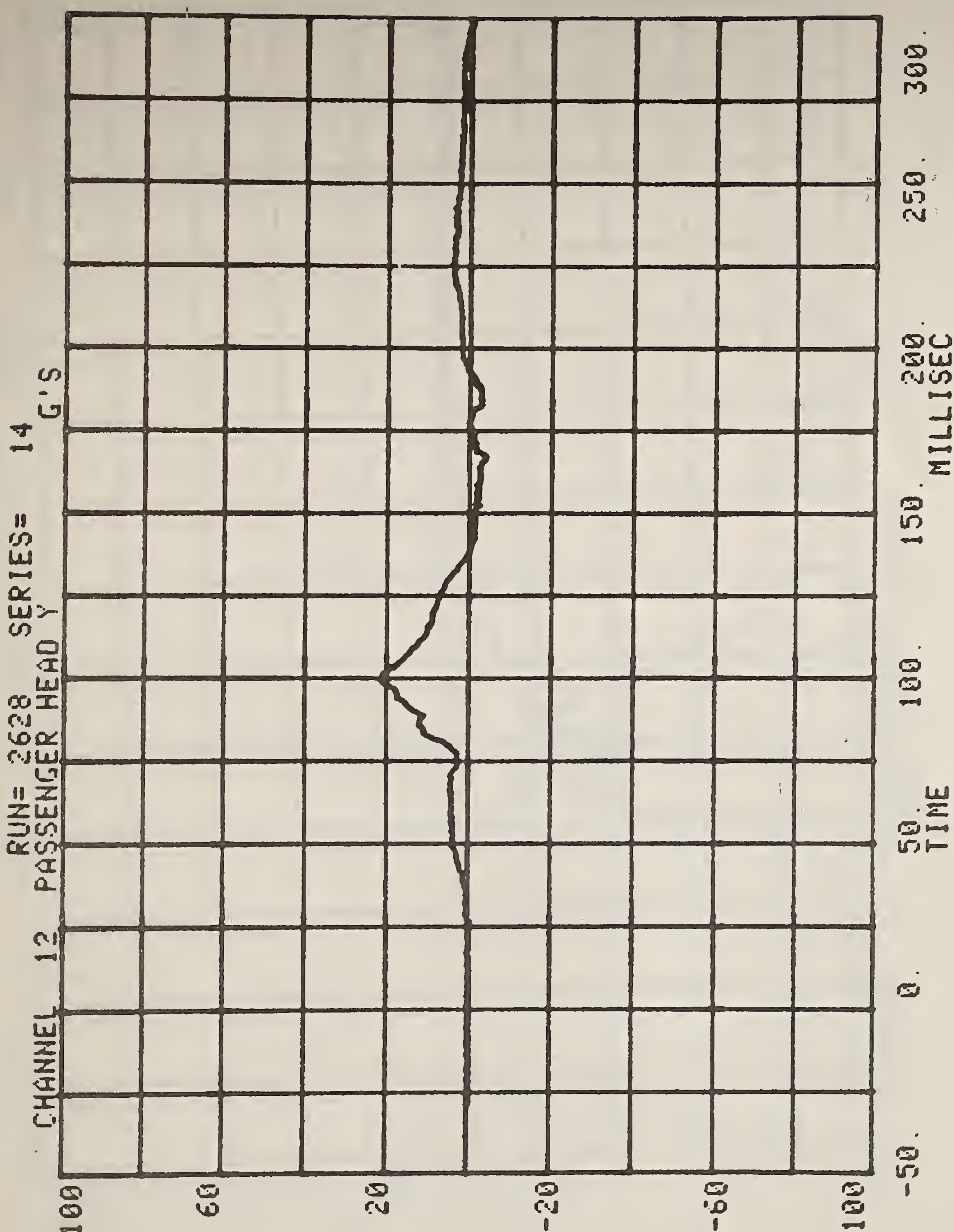
HIC= 249.7   FROM T1= .05760   TO T2= .11040

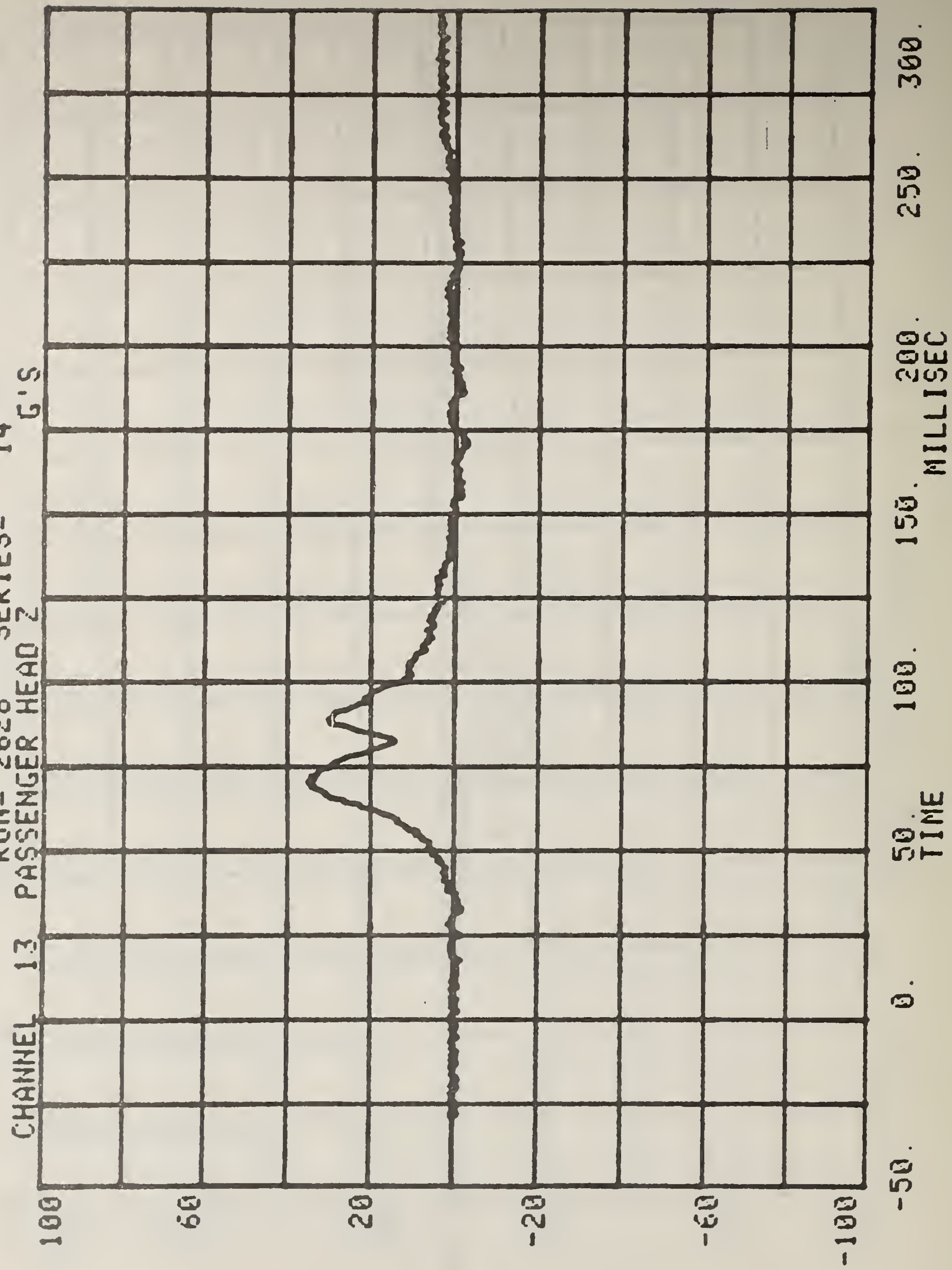
AVERAGE ACCELERATION BETWEEN T1 AND T2= 29.5G'S

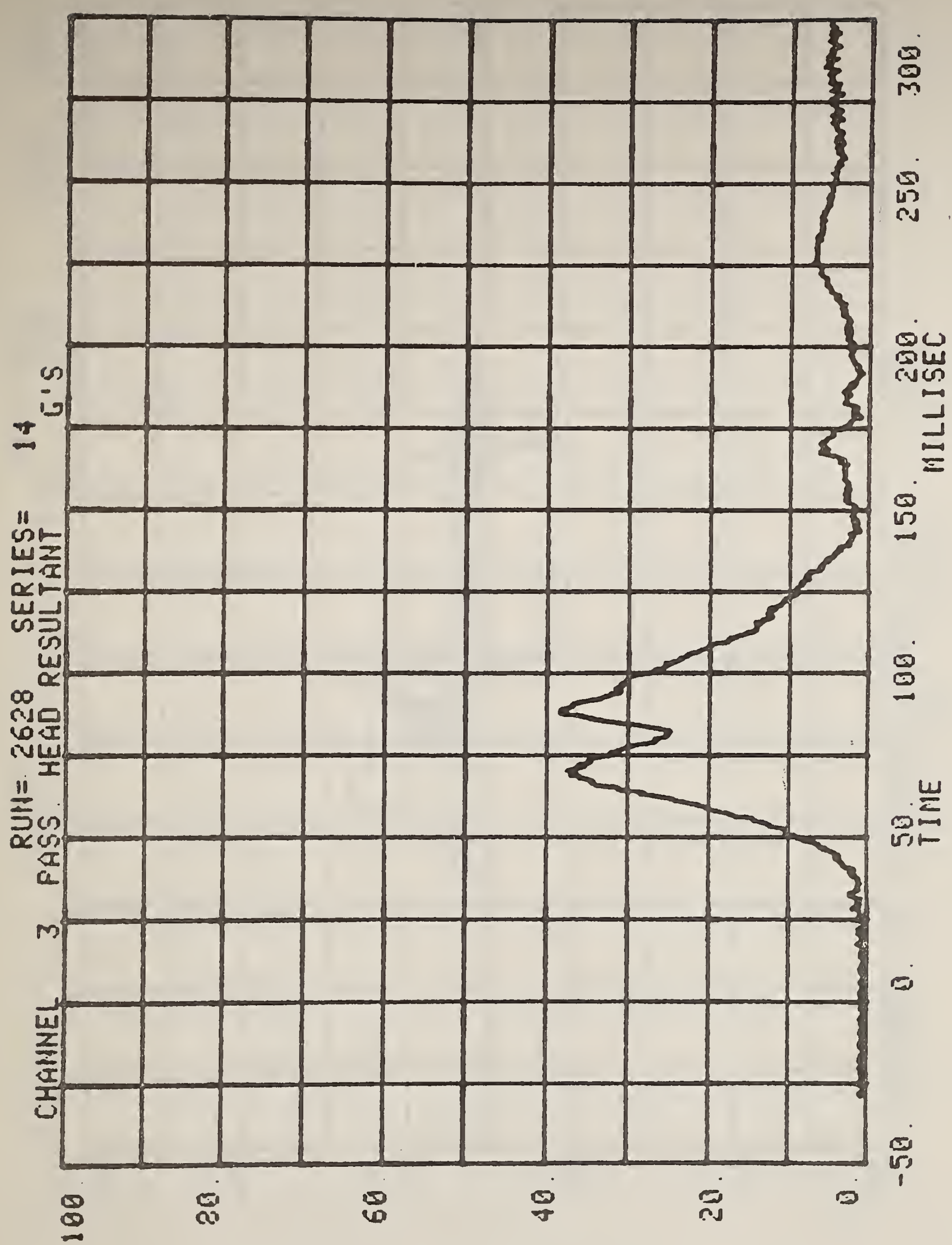
EVENT TIME= 300.0 MSEC

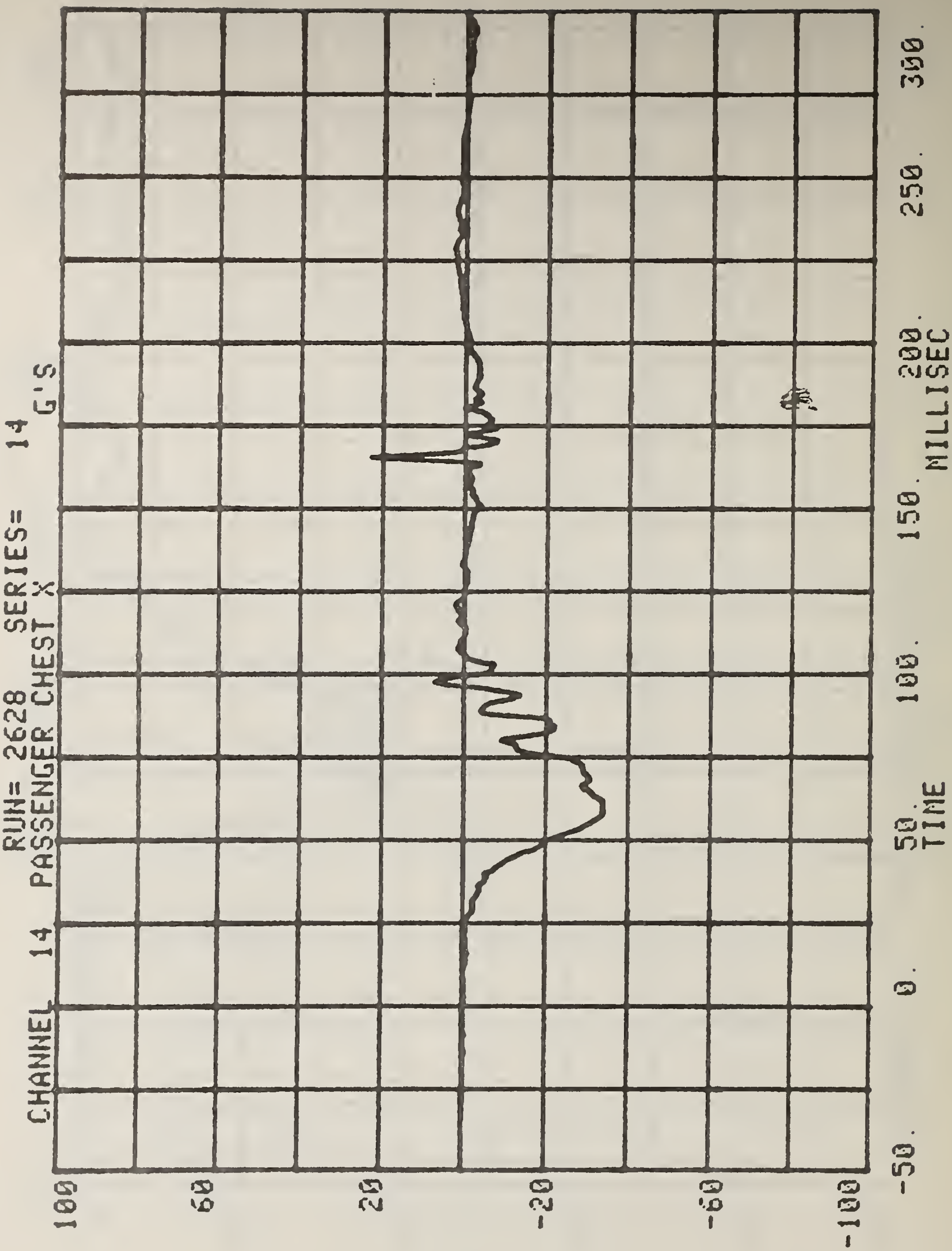
SEVERITY INDEX= 289.3

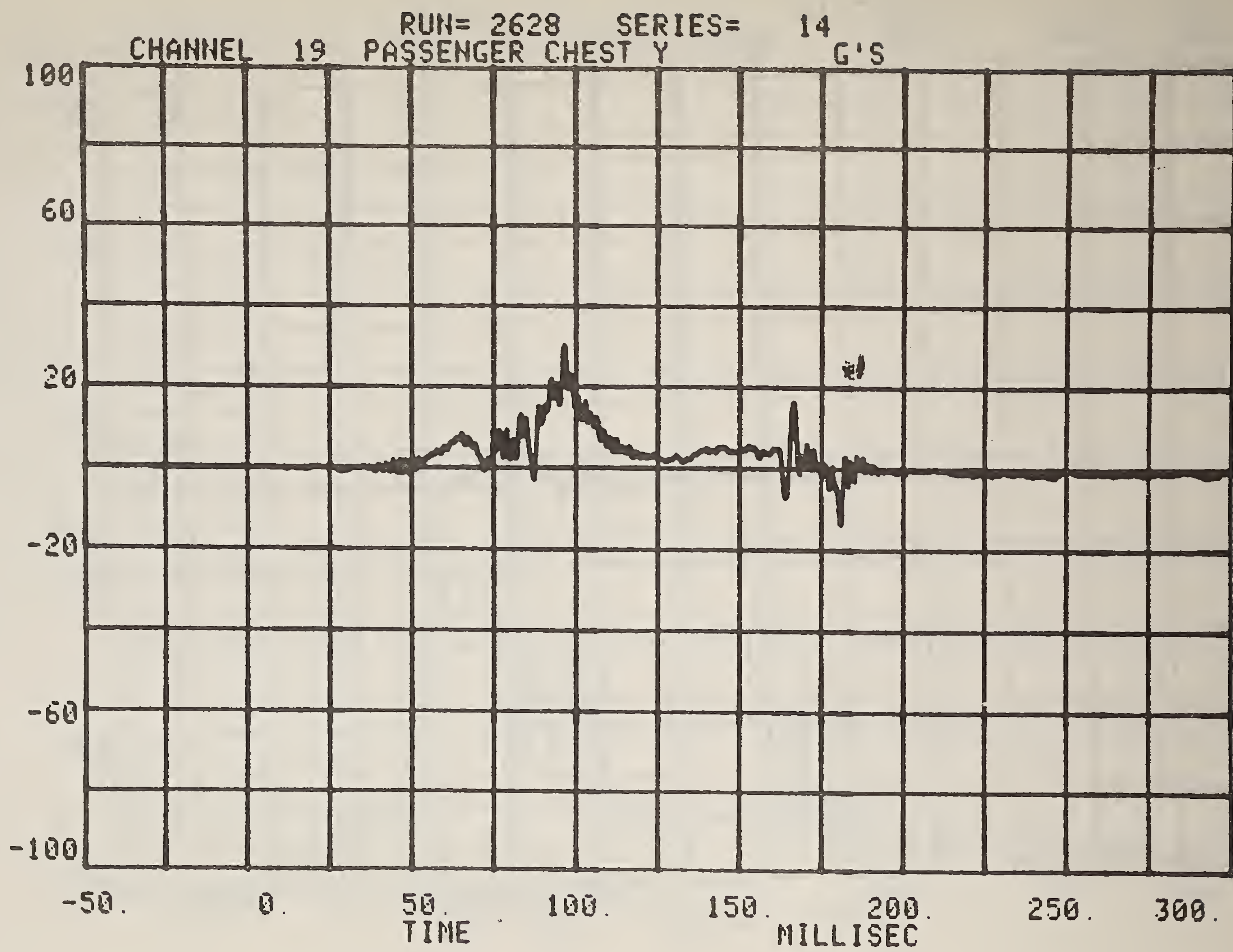

CHANNEL 11 RUN= 2628 SERIES= 14
PASSENGER HEAD X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

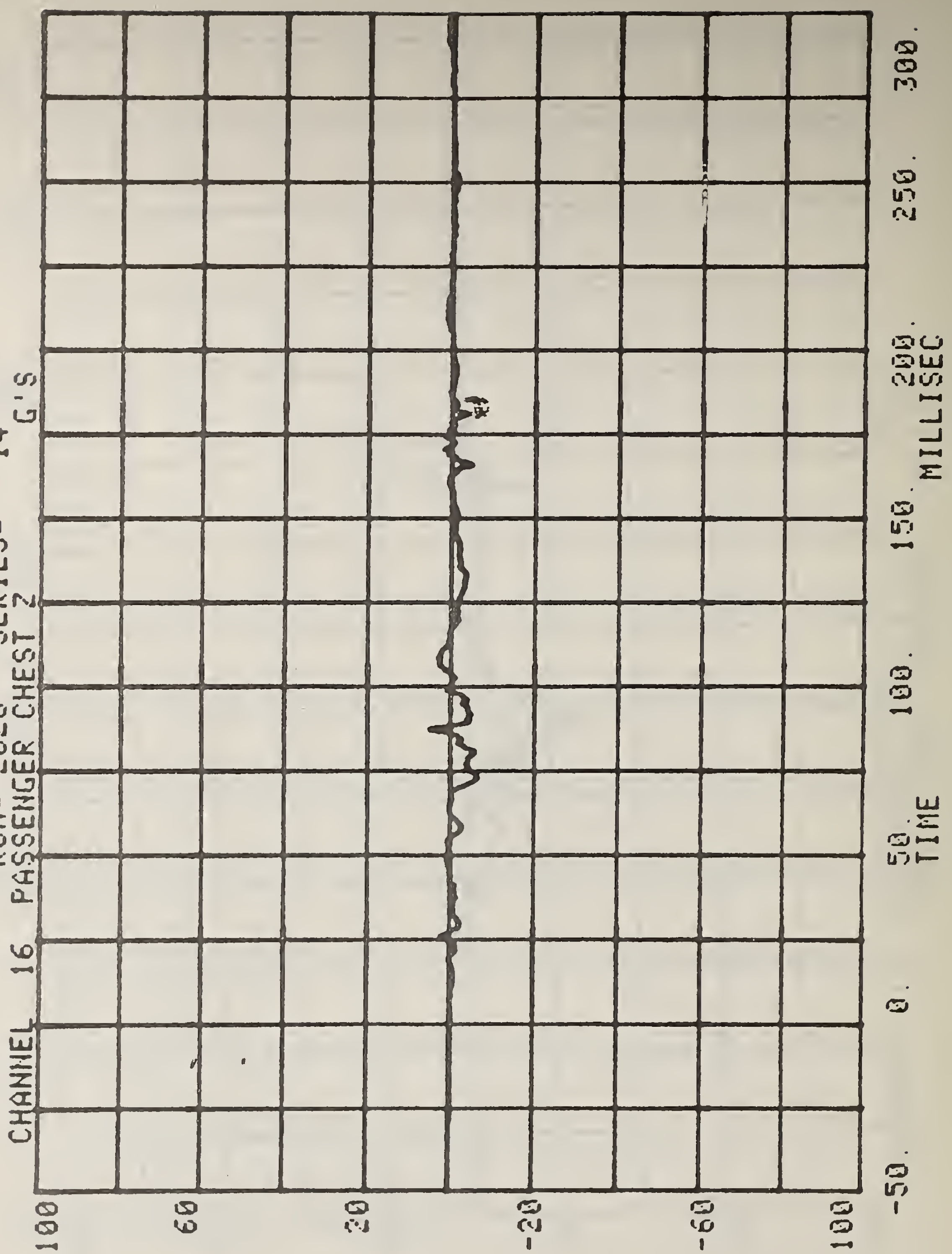

CHANNEL 12 RUN= 2628 SERIES= 14
PASSENGER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

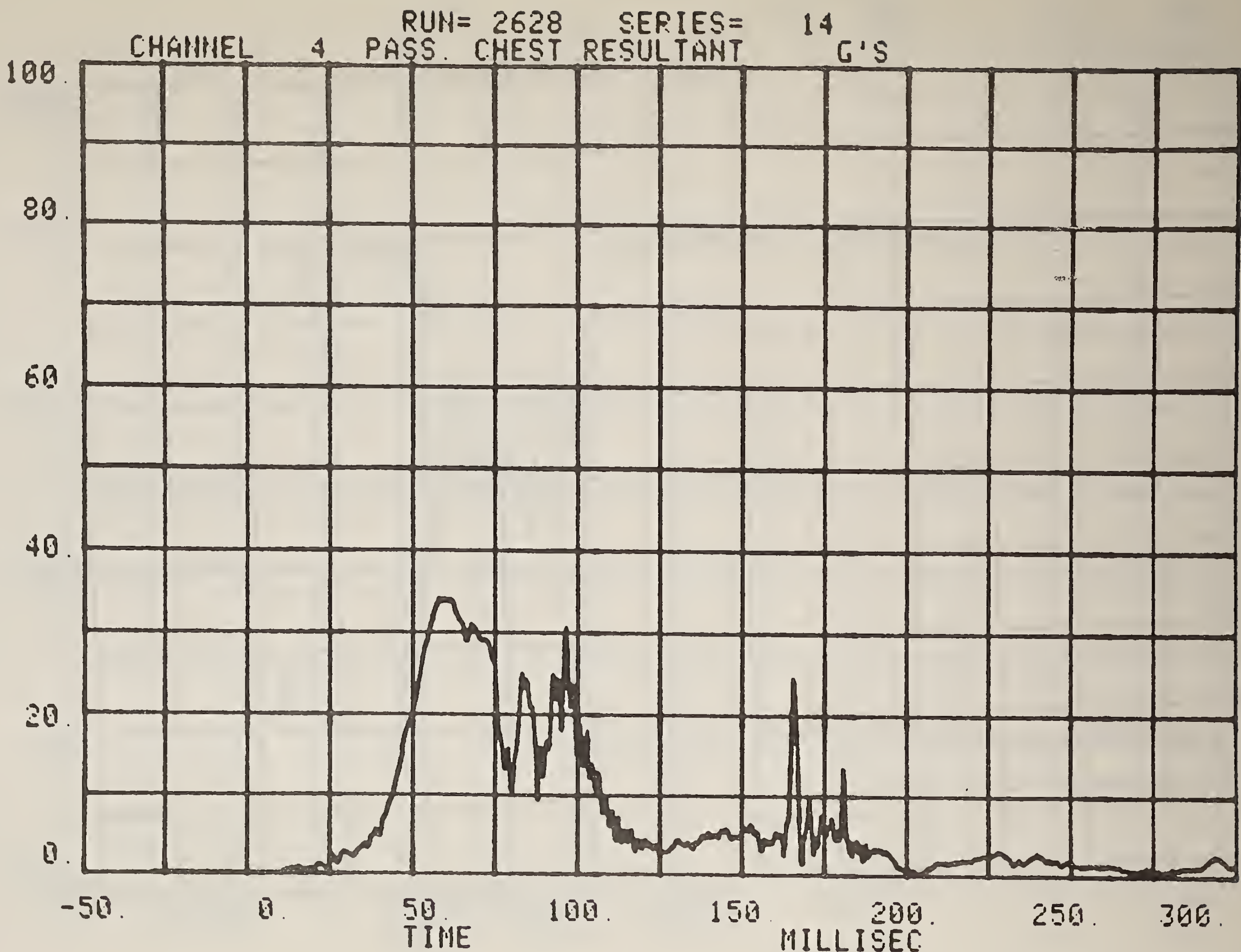

CHANNEL 13 RUN= 2628 SERIES= 14
PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

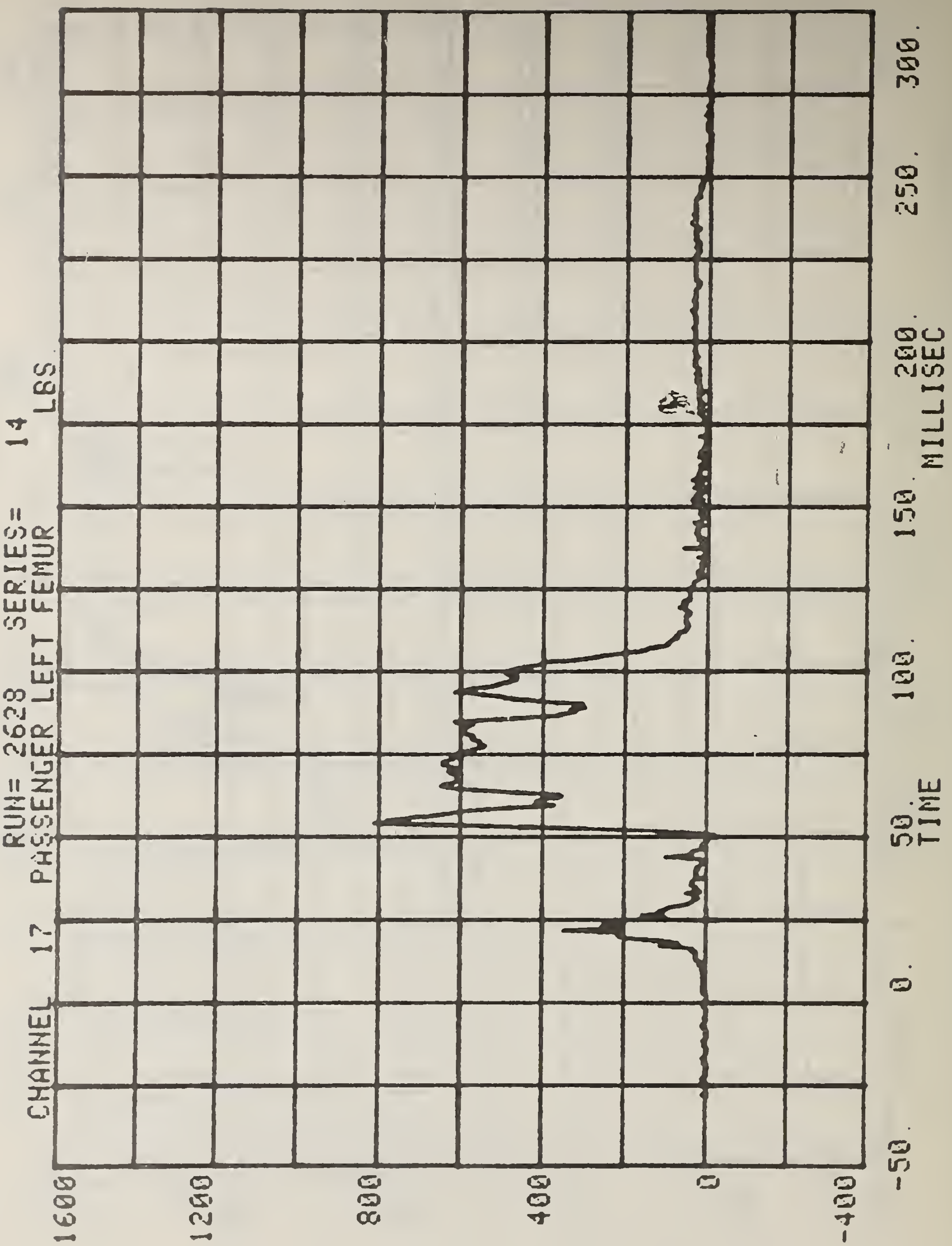

CHANNEL 3 RUN= 2628 SERIES= 14
PASS. HEAD RESULTANT G'S
100
80.
60
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 14 RUN= 2628 SERIES= 14
PASSENGER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

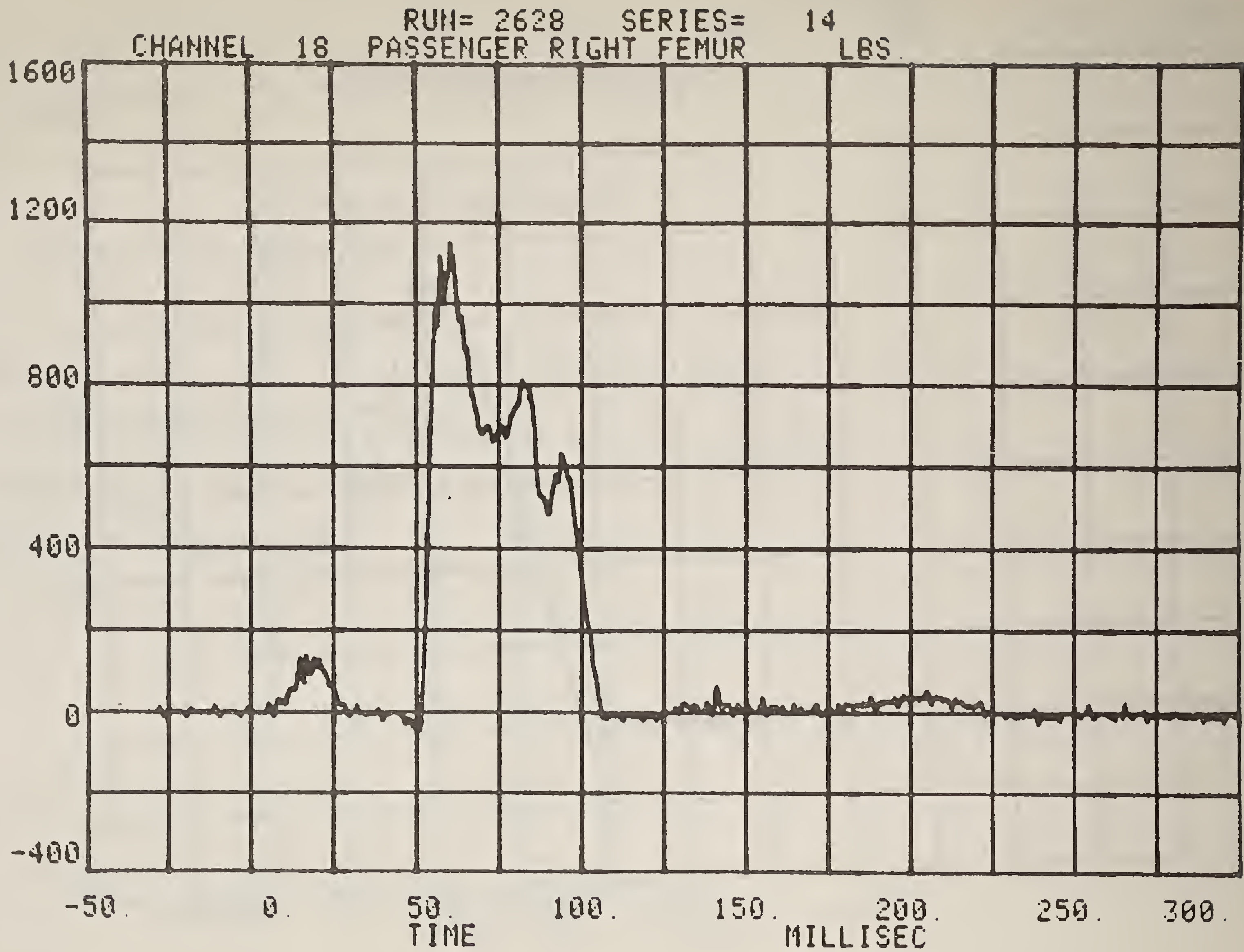

RUN= 2628 SERIES= 14
CHANNEL 19 PASSENGER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

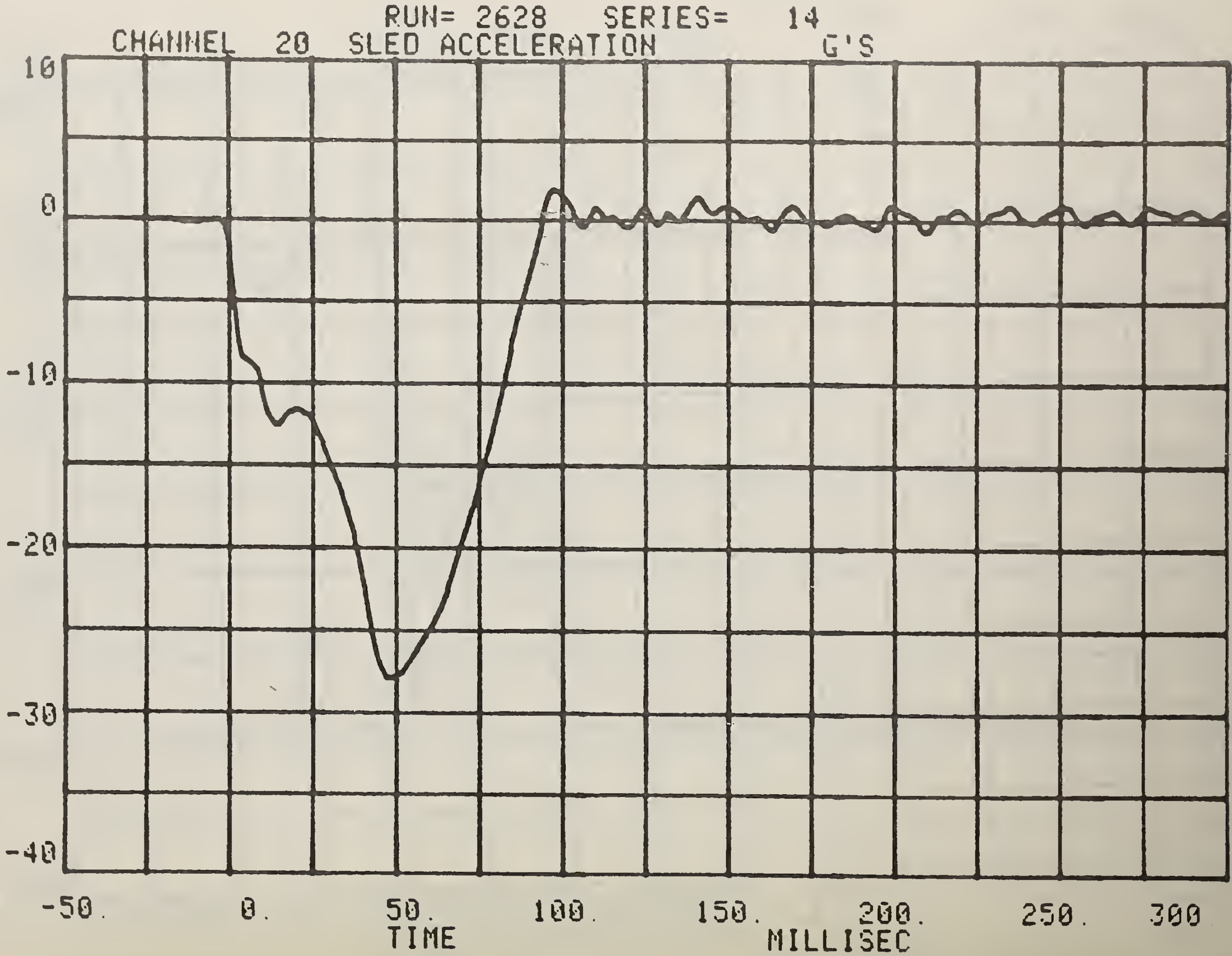

CHANNEL 16 RUN= 2628 SERIES= 14
PASSENGER CHEST Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2628 SERIES= 14
CHANNEL 4 PASS. CHEST RESULTANT G'S
100.
80.
60
40.
20.
0.
-50.
0.
50.
100.
150
200.
250.
300.
TIME
MILLISEC



CHANNEL 17 RUN= 2628 SERIES= 14
PASSENGER LEFT FEMUR LBS
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2628 SERIES= 14
CHANNEL 18 PASSENGER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2628 SERIES= 14
CHANNEL 20 SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2629

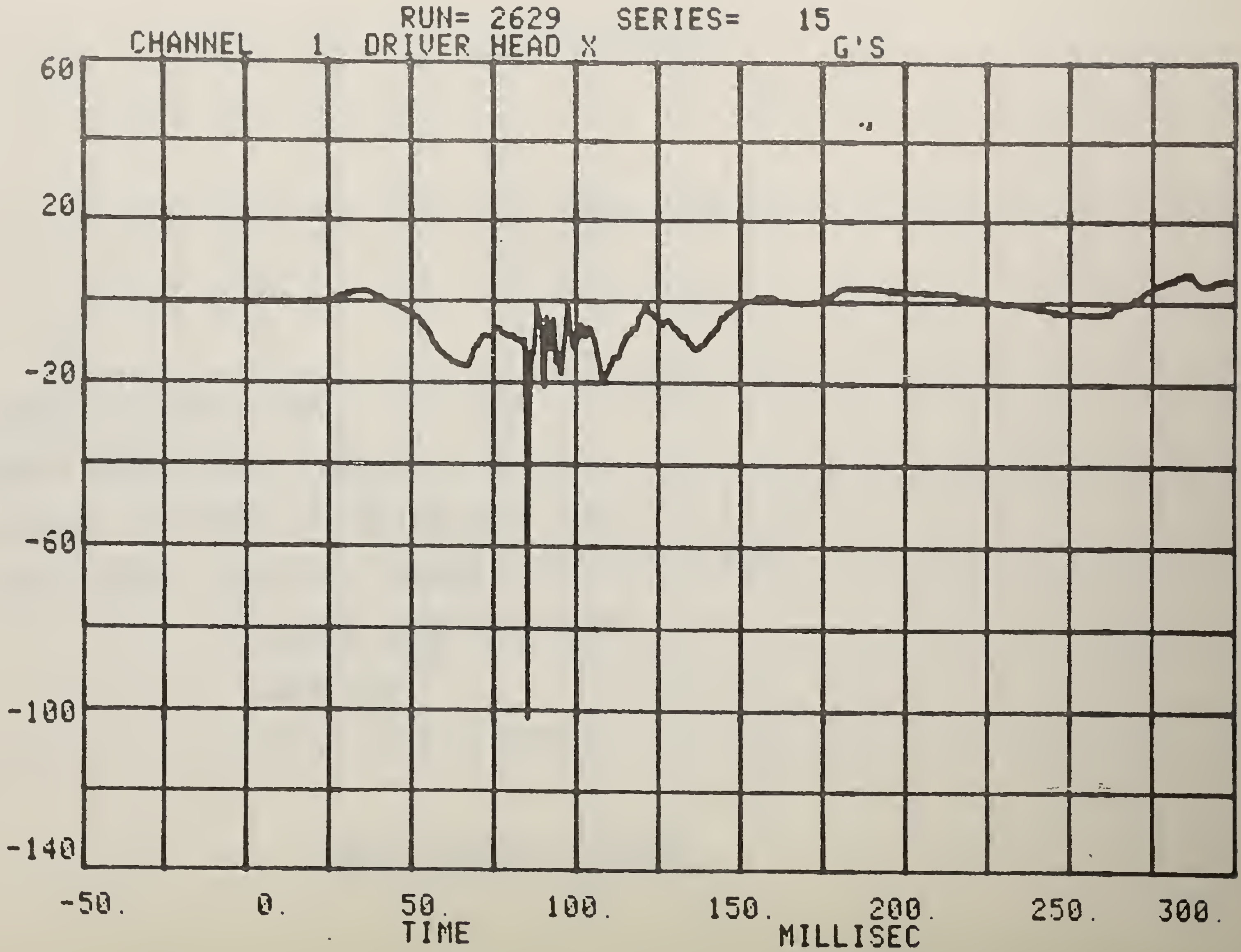
DRIVER HEAD RESULTANT

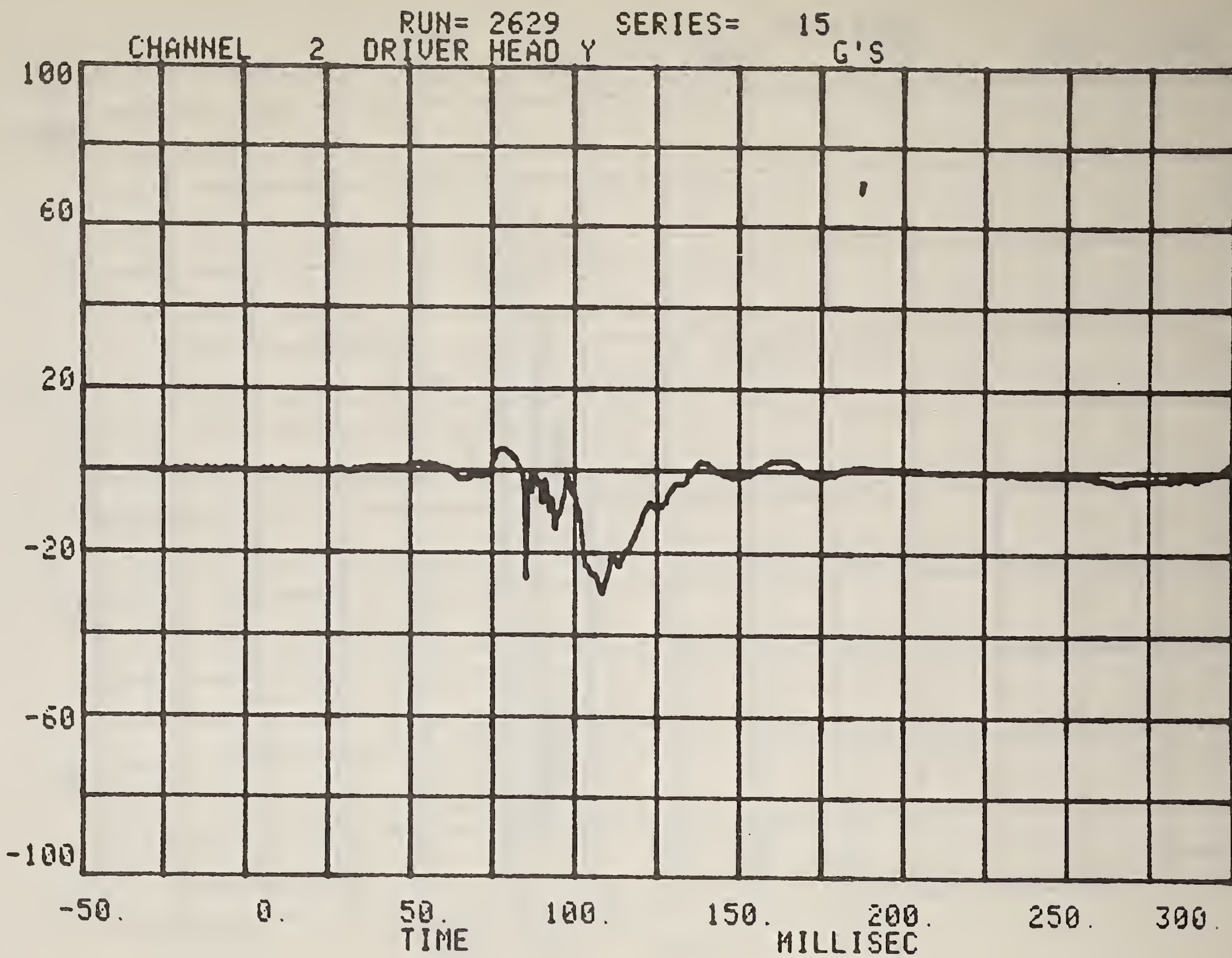
HIC= 328.0 FROM T1= .06060 TO T2= .11850

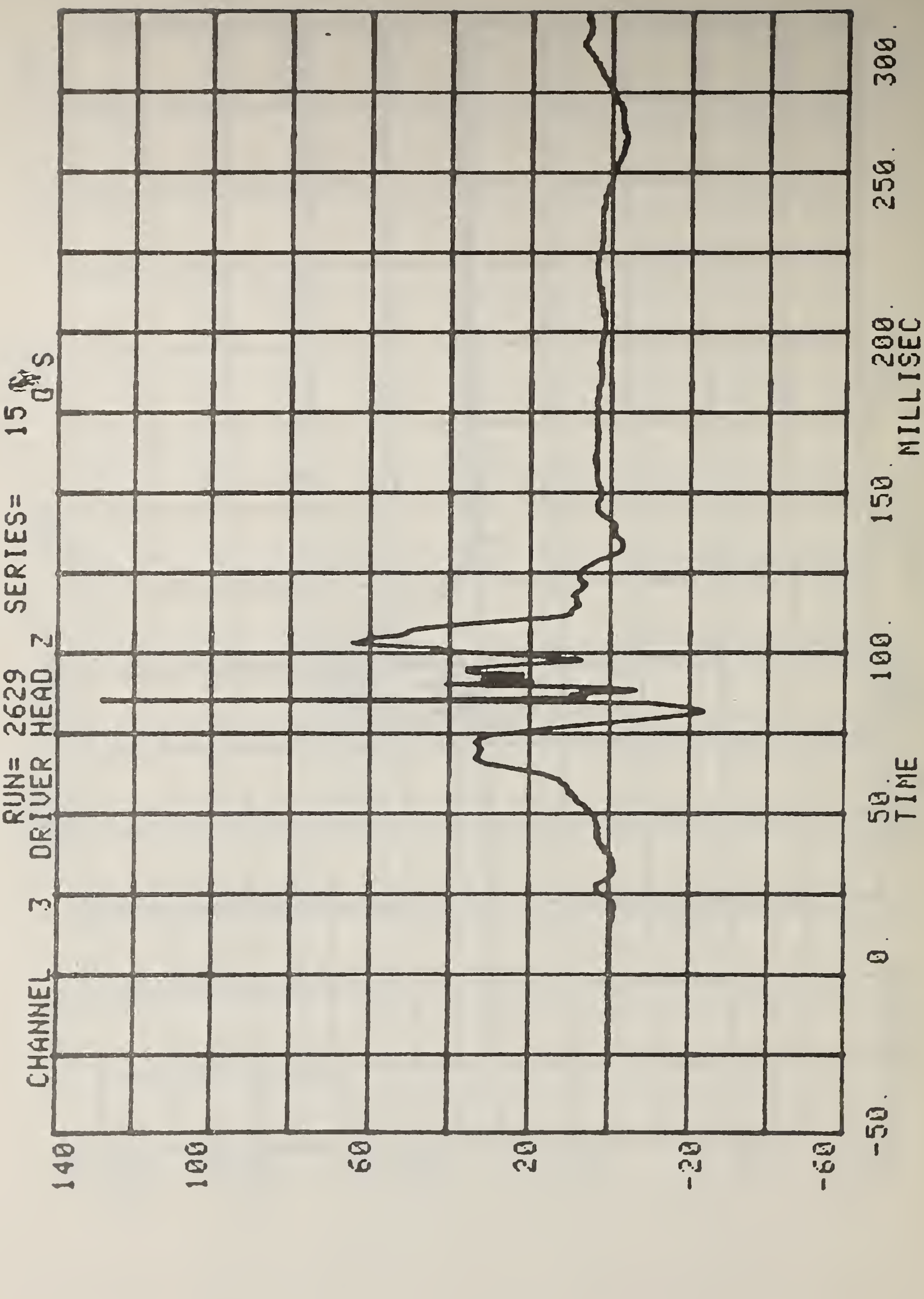
AVERAGE ACCELERATION BETWEEN T1 AND T2= 31.7G'S

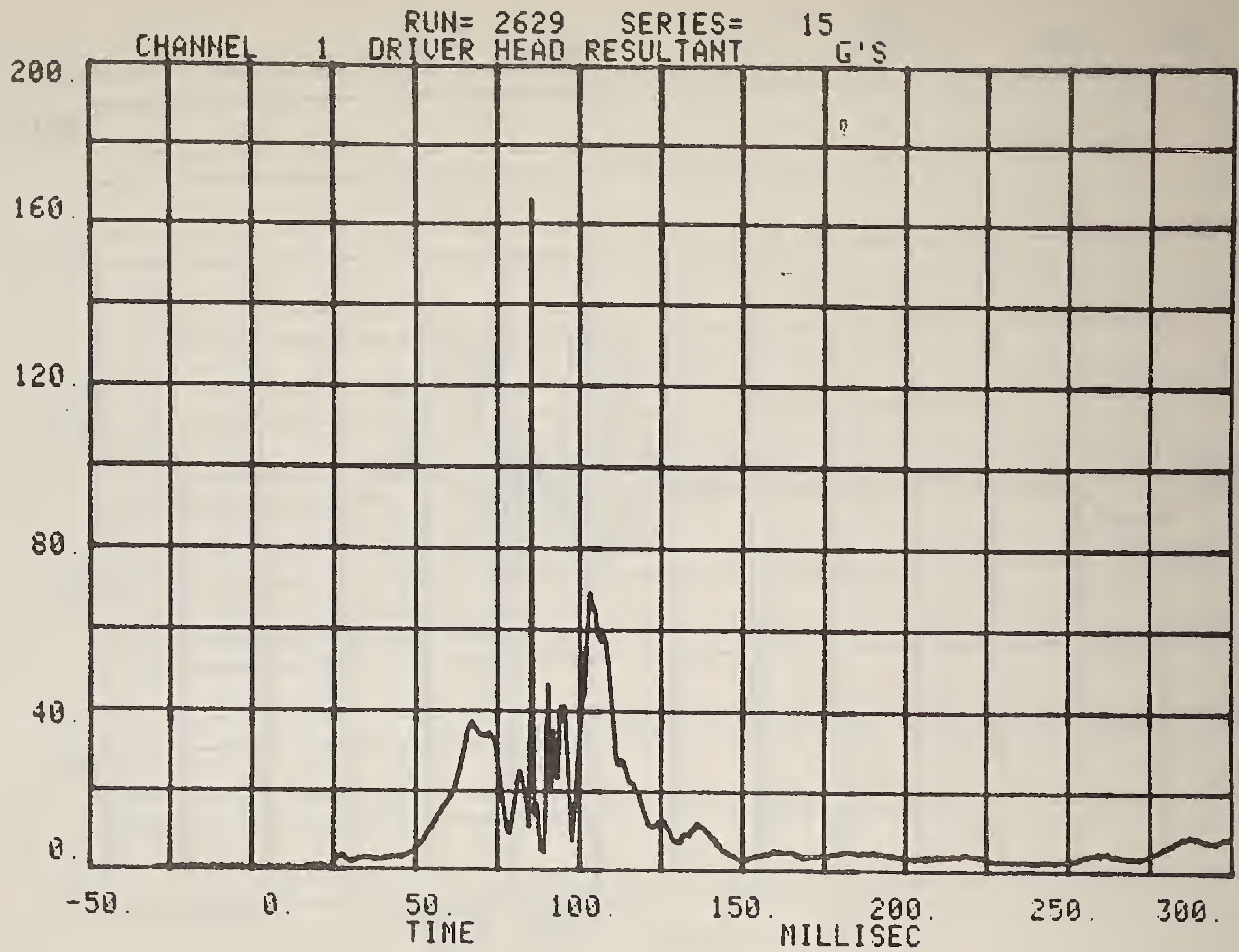
EVENT TIME= 300.0 MSEC

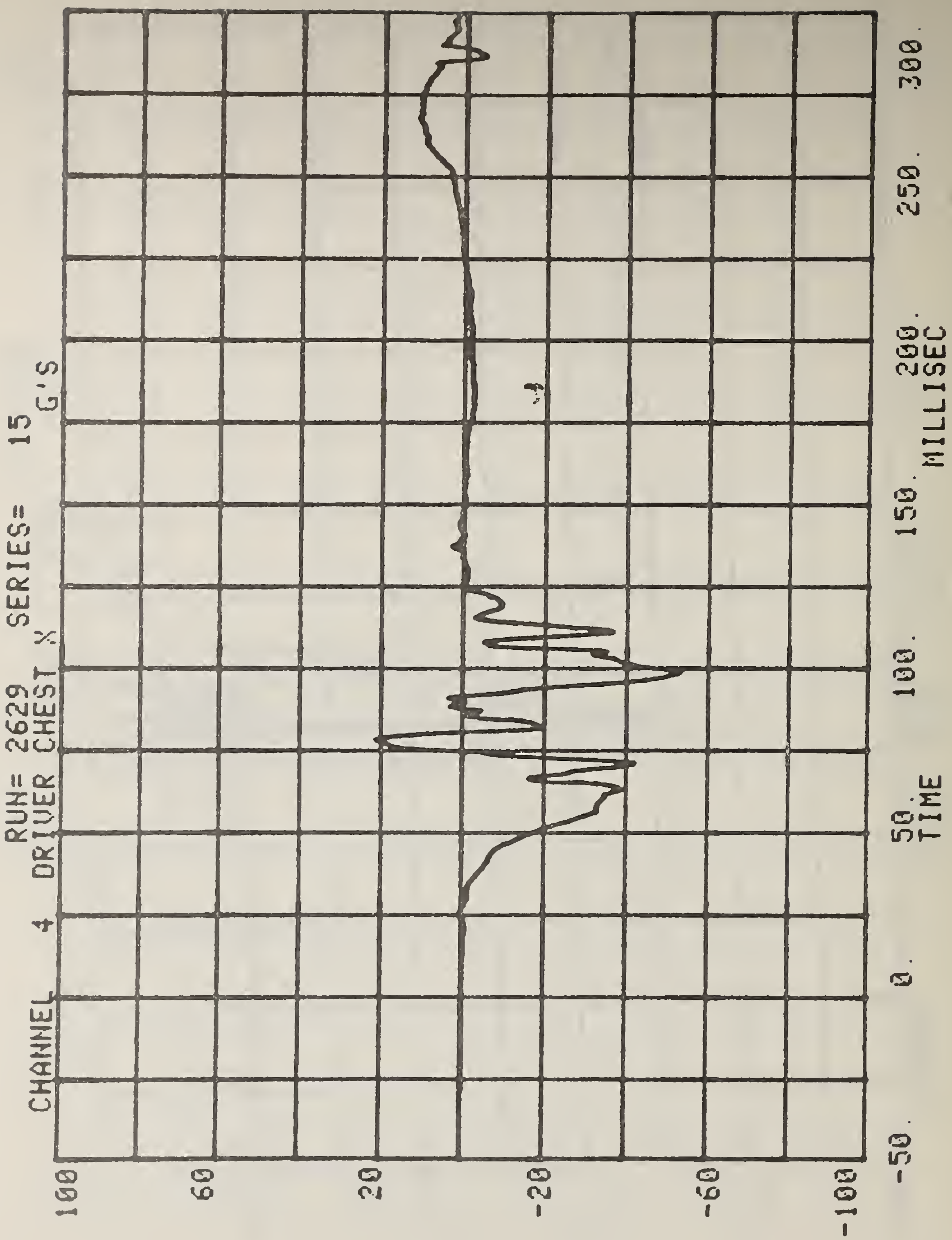
SEVERITY INDEX= 571.7

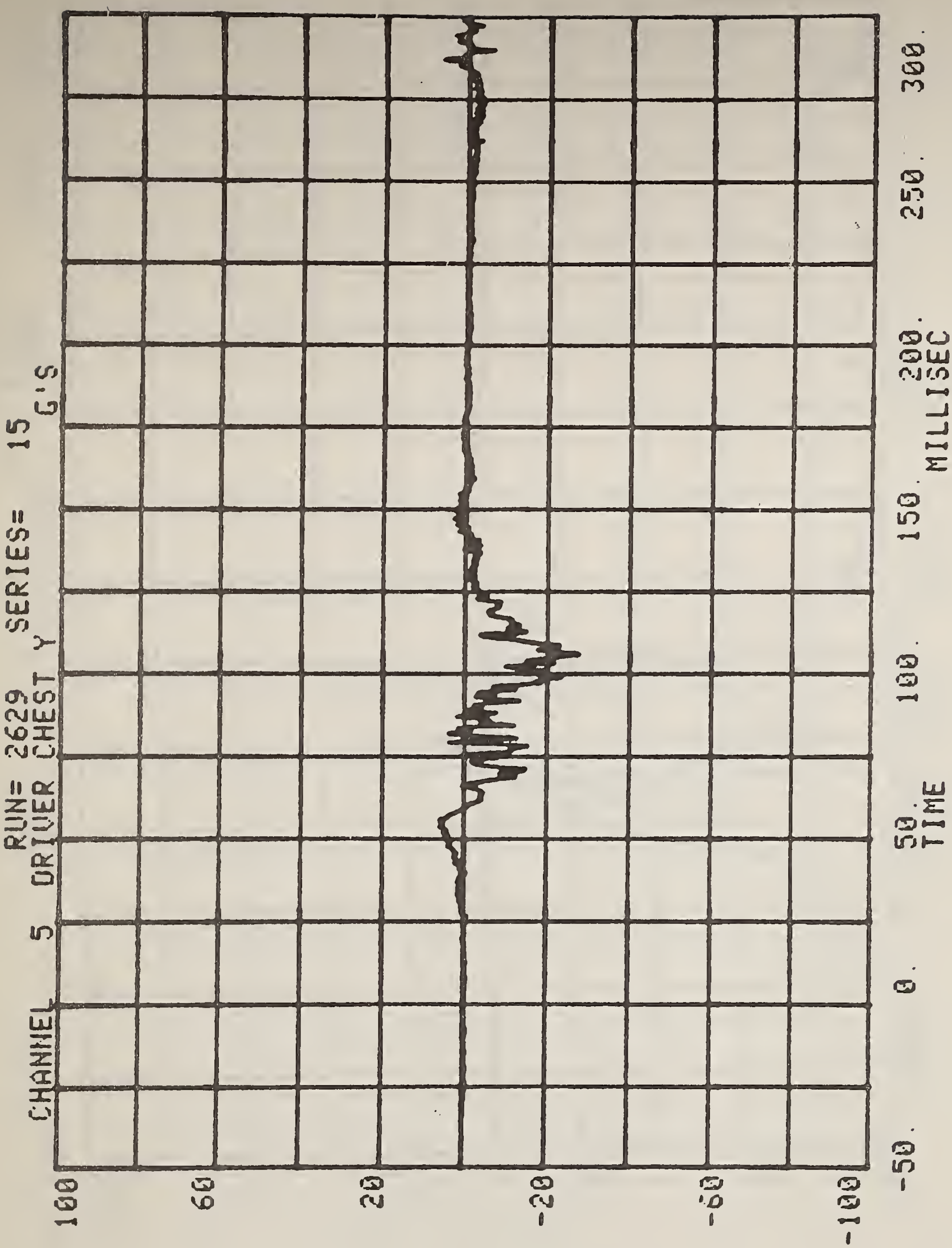

RUN= 2629 SERIES= 15
CHANNEL 1 DRIVER HEAD X
G'S
60
20
-20
-60
-100
-140
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

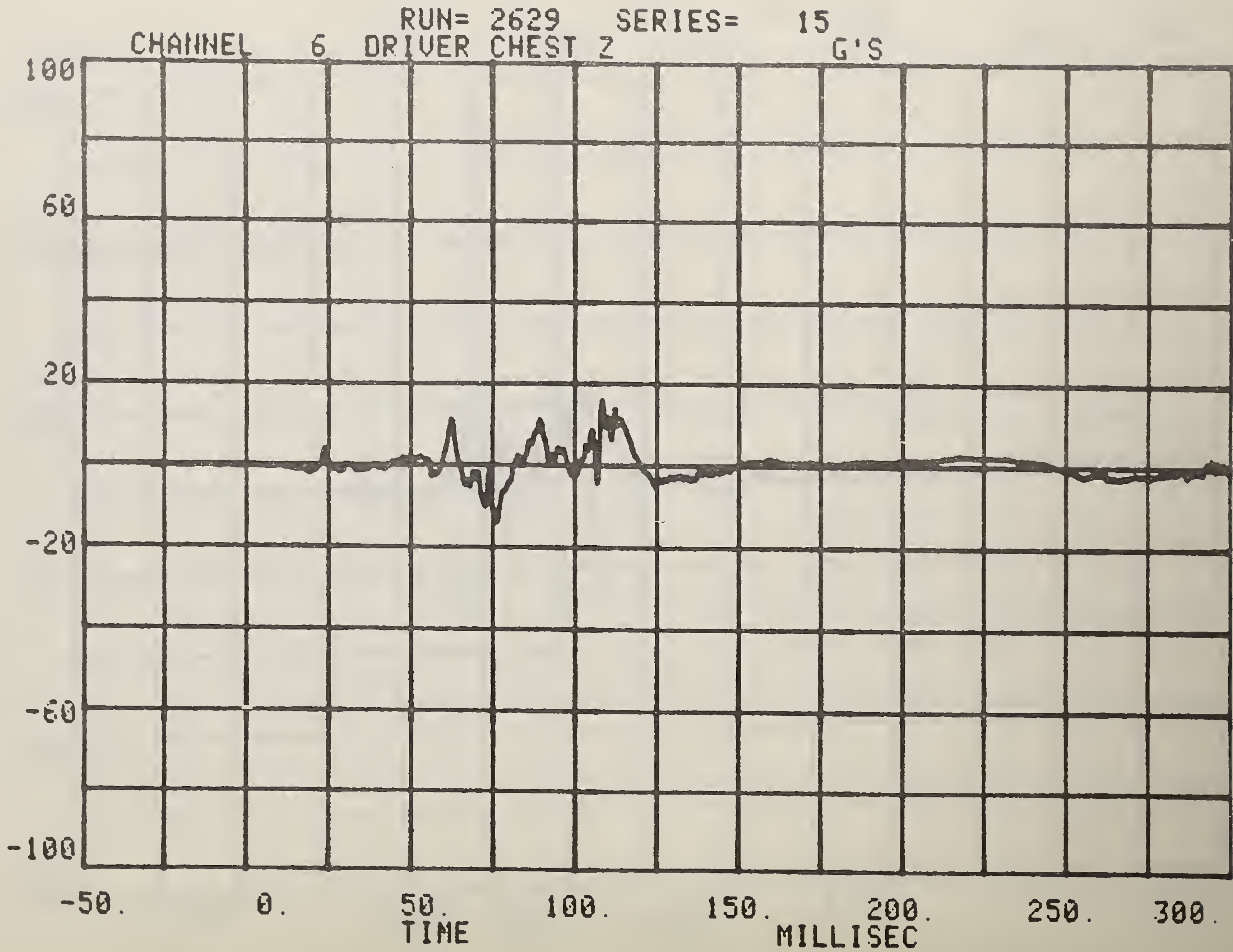

RUN= 2629 SERIES= 15
CHANNEL 2 DRIVER HEAD Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

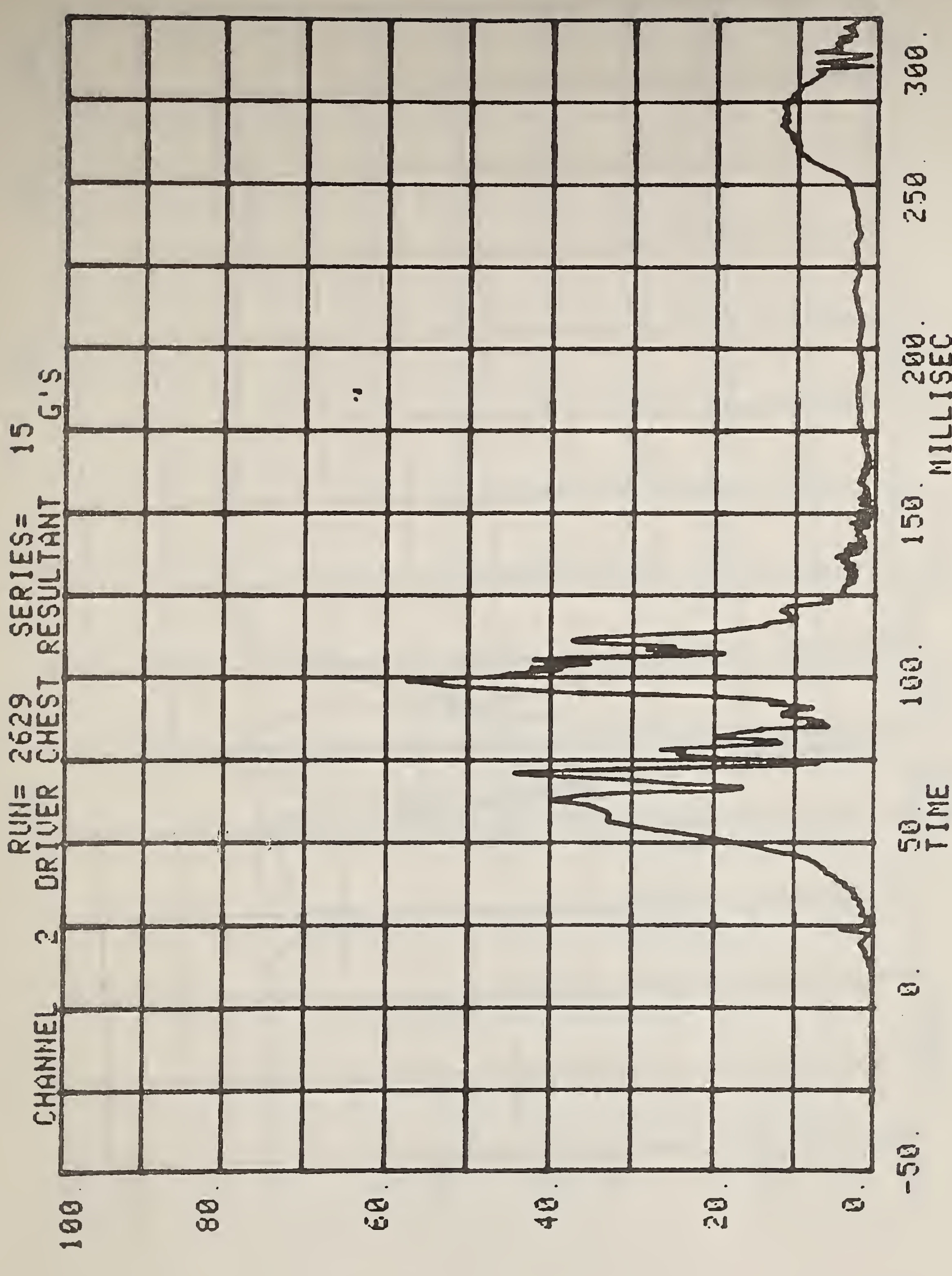

CHANNEL 3 RUN= 2629 SERIES= 15
DRIVER HEAD Z
G'S
140
100
60
20
-20
-60
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

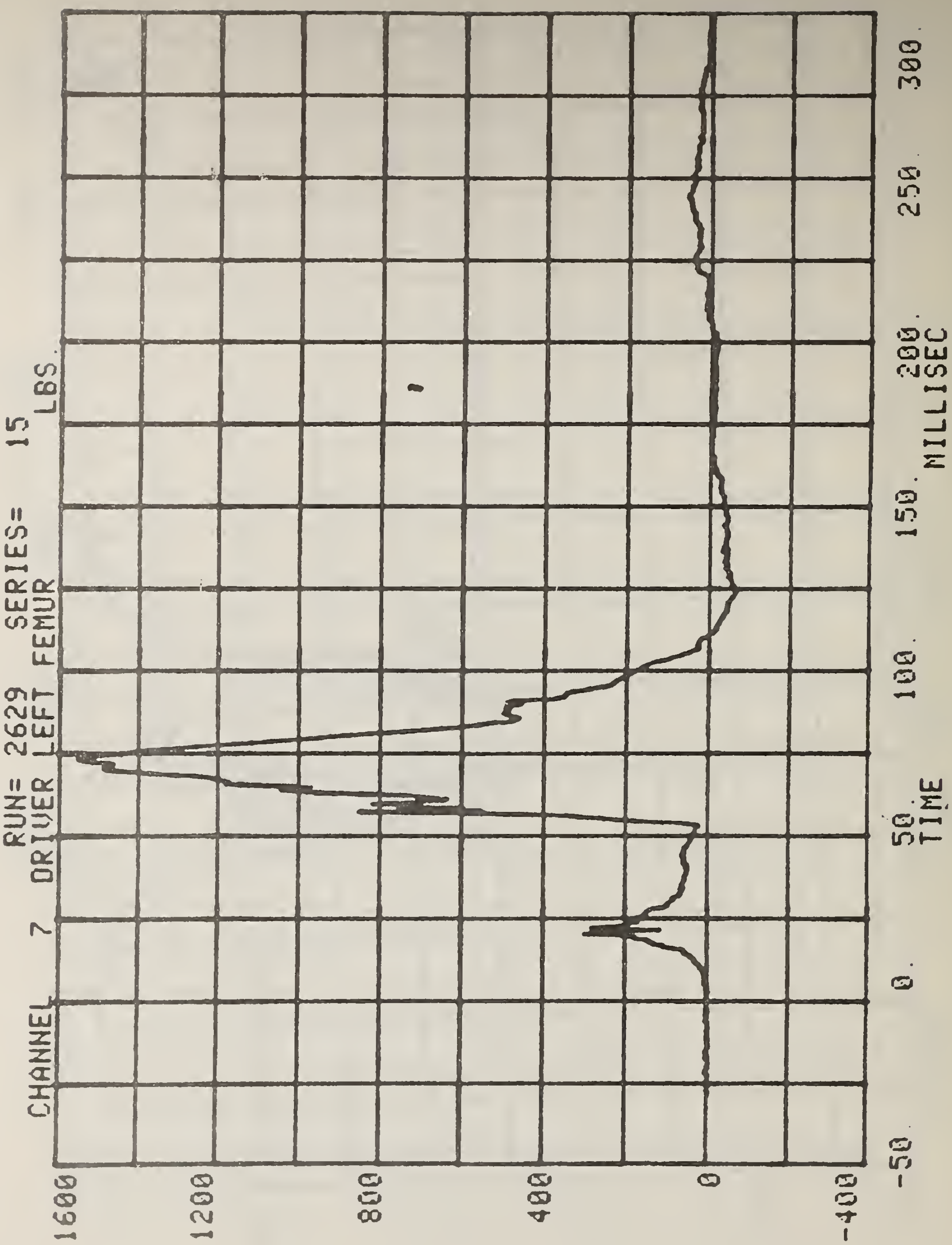

RUN= 2629 SERIES= 15
CHANNEL 1 DRIVER HEAD RESULTANT G'S
200.
160.
120.
80.
40.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

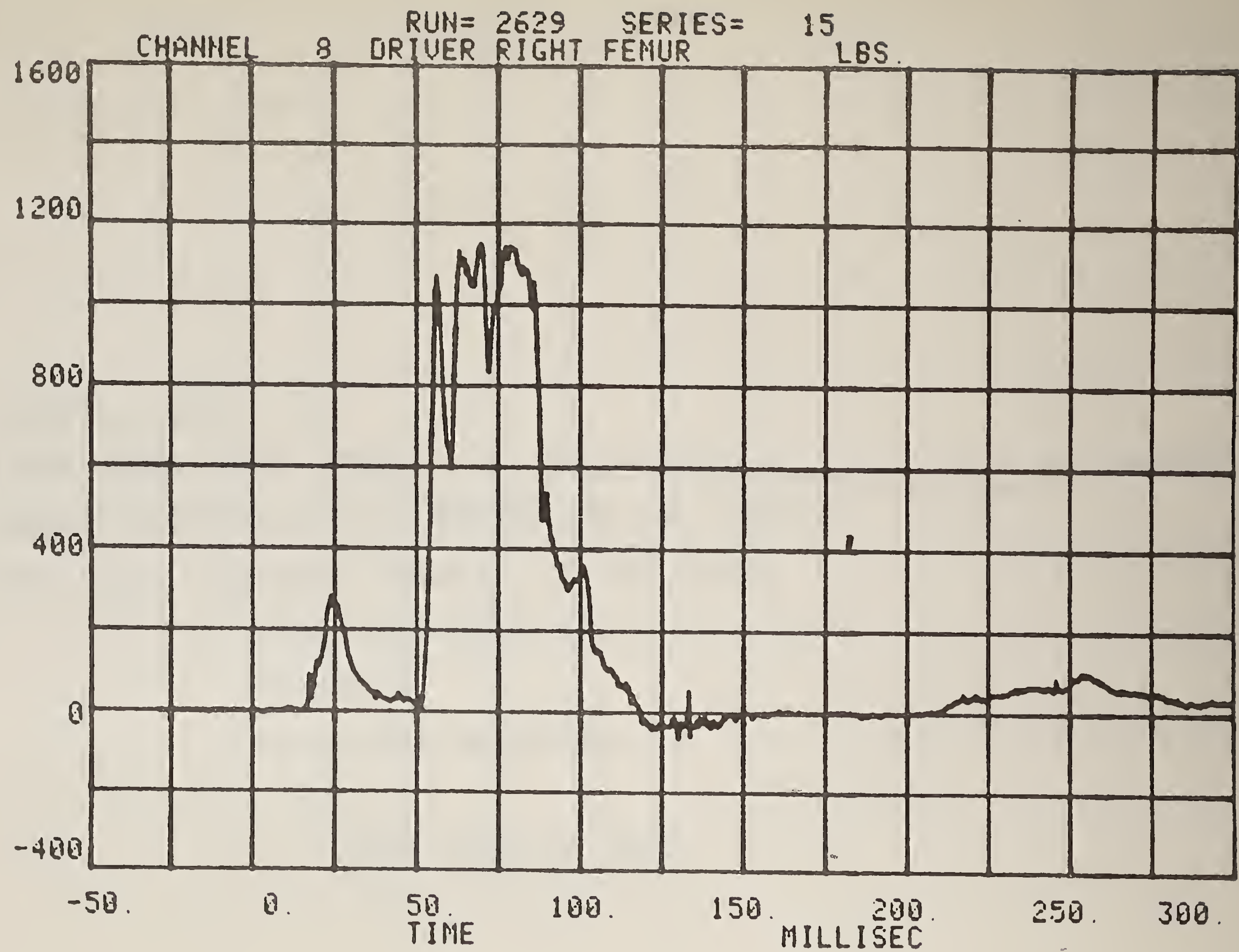

CHANNEL 4 RUN= 2629 SERIES= 15
DRIVER CHEST X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 5 RUN= 2629 SERIES= 15
DRIVER CHEST Y G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2629 SERIES= 15
CHANNEL 6 DRIVER CHEST Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 2 RUN= 2629 SERIES= 15
DRIVER CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


CHANNEL 7 RUN= 2629 SERIES= 15
DRIVER LEFT FEMUR LBS
1600
1200
800
400
0
-400
-50
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC


RUN= 2629 SERIES= 15
CHANNEL 8 DRIVER RIGHT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

VW PASSIVE RESTRAINT

RUN=2629

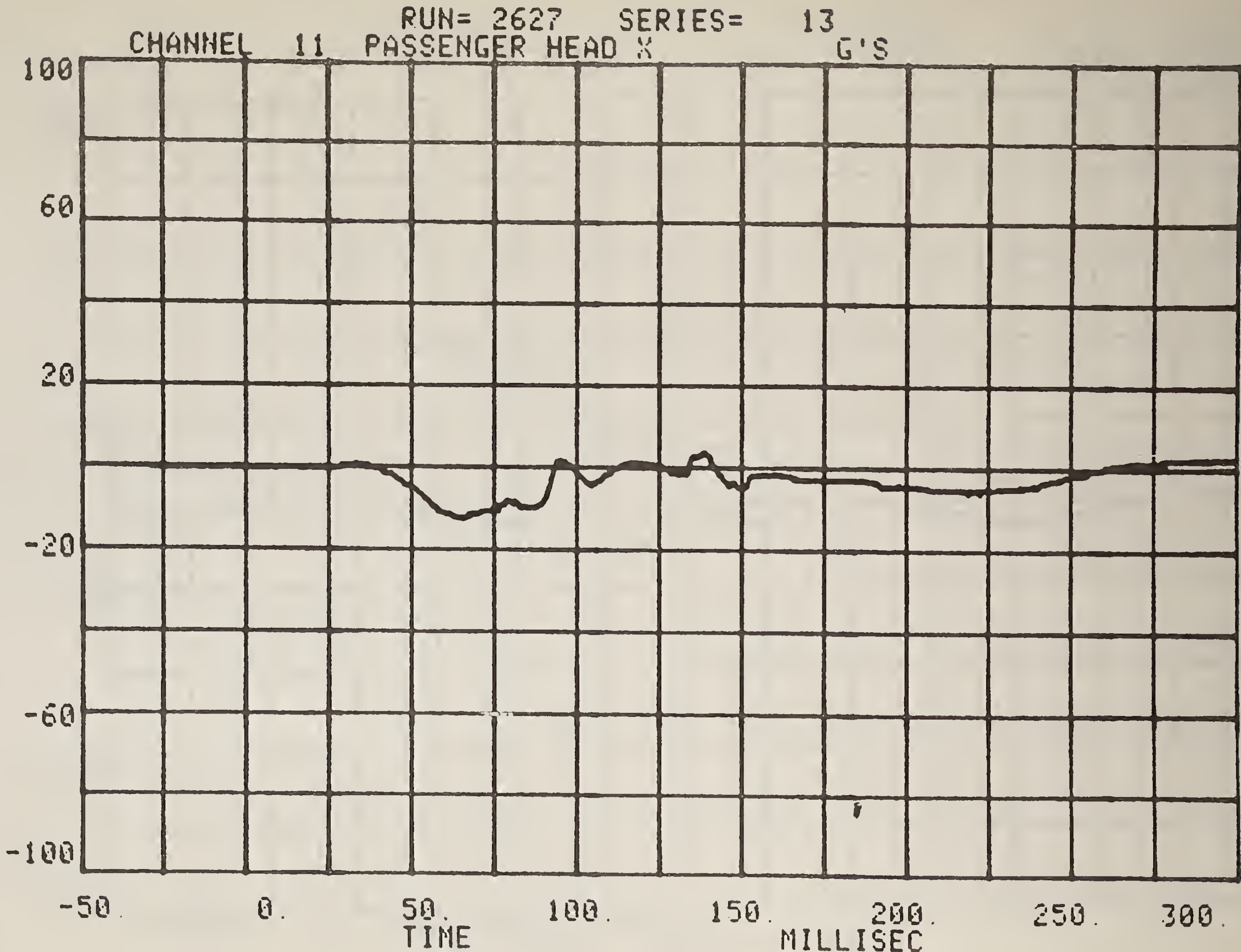
PASS. HEAD RESULTANT

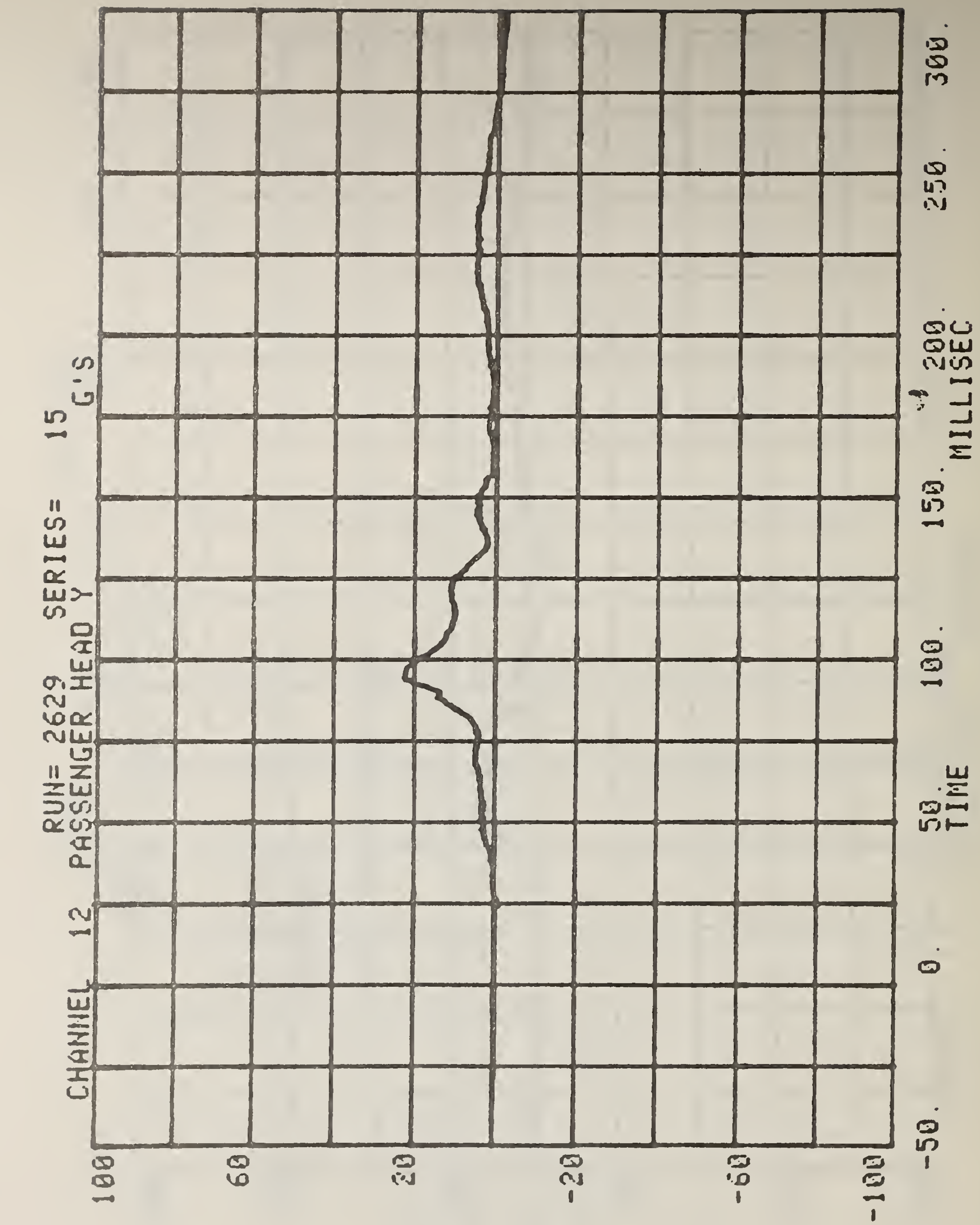
HIC= 174.6   FROM T1= .05910   TO T2= .10650

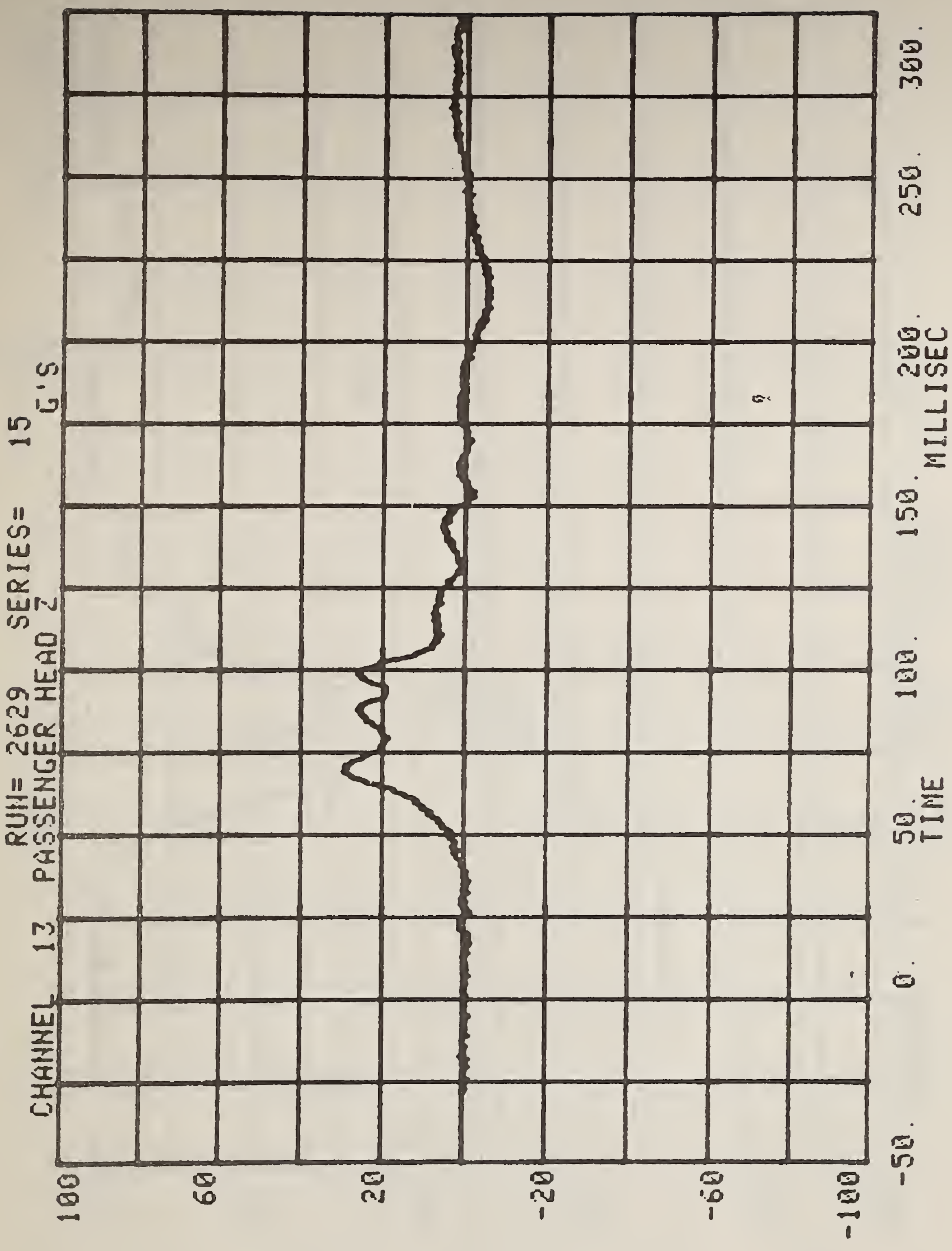
AVERAGE ACCELERATION BETWEEN T1 AND T2= 26.7G'S

EVENT TIME= 300.0 MSEC

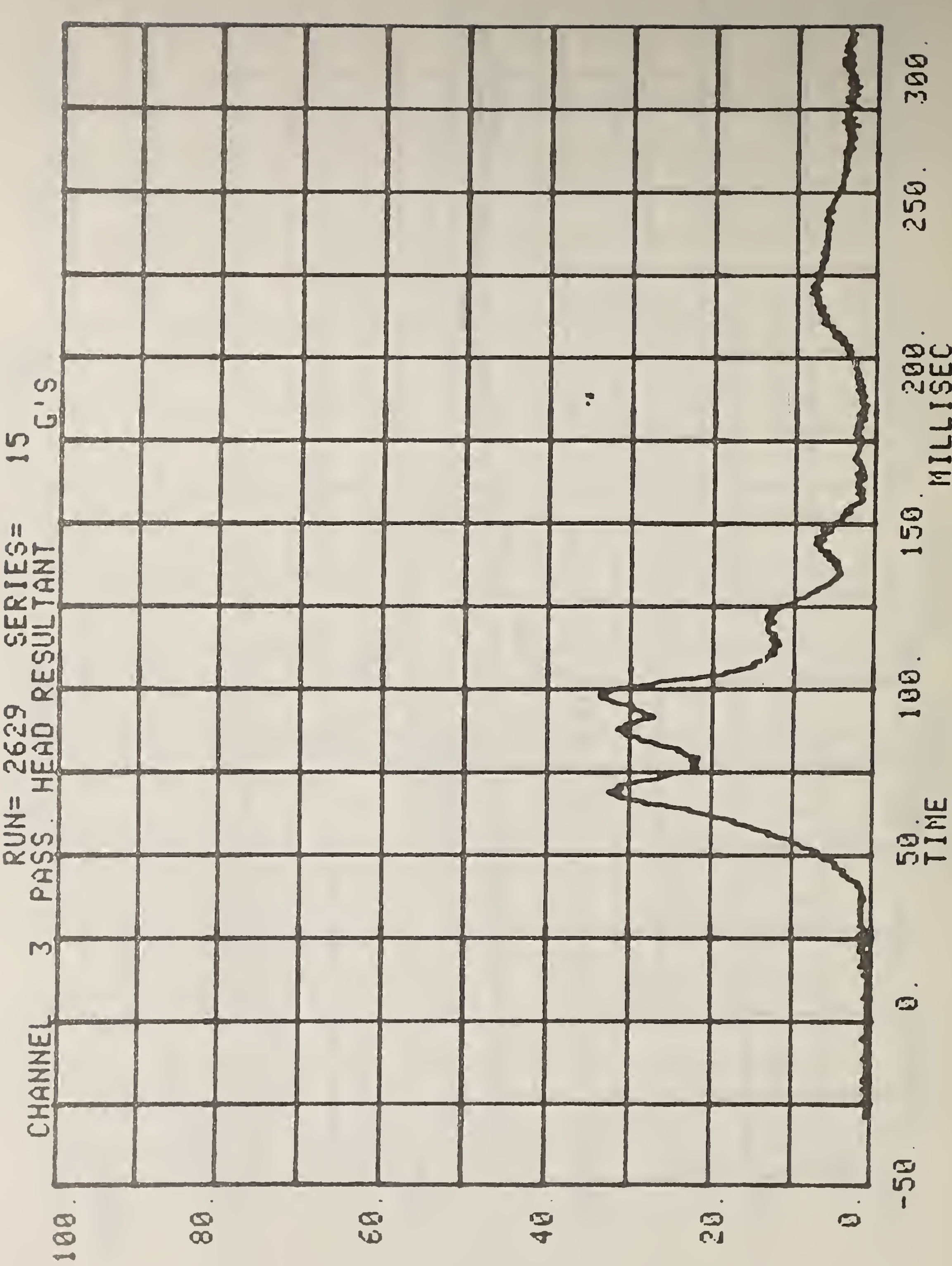
SEVERITY INDEX= 210.5

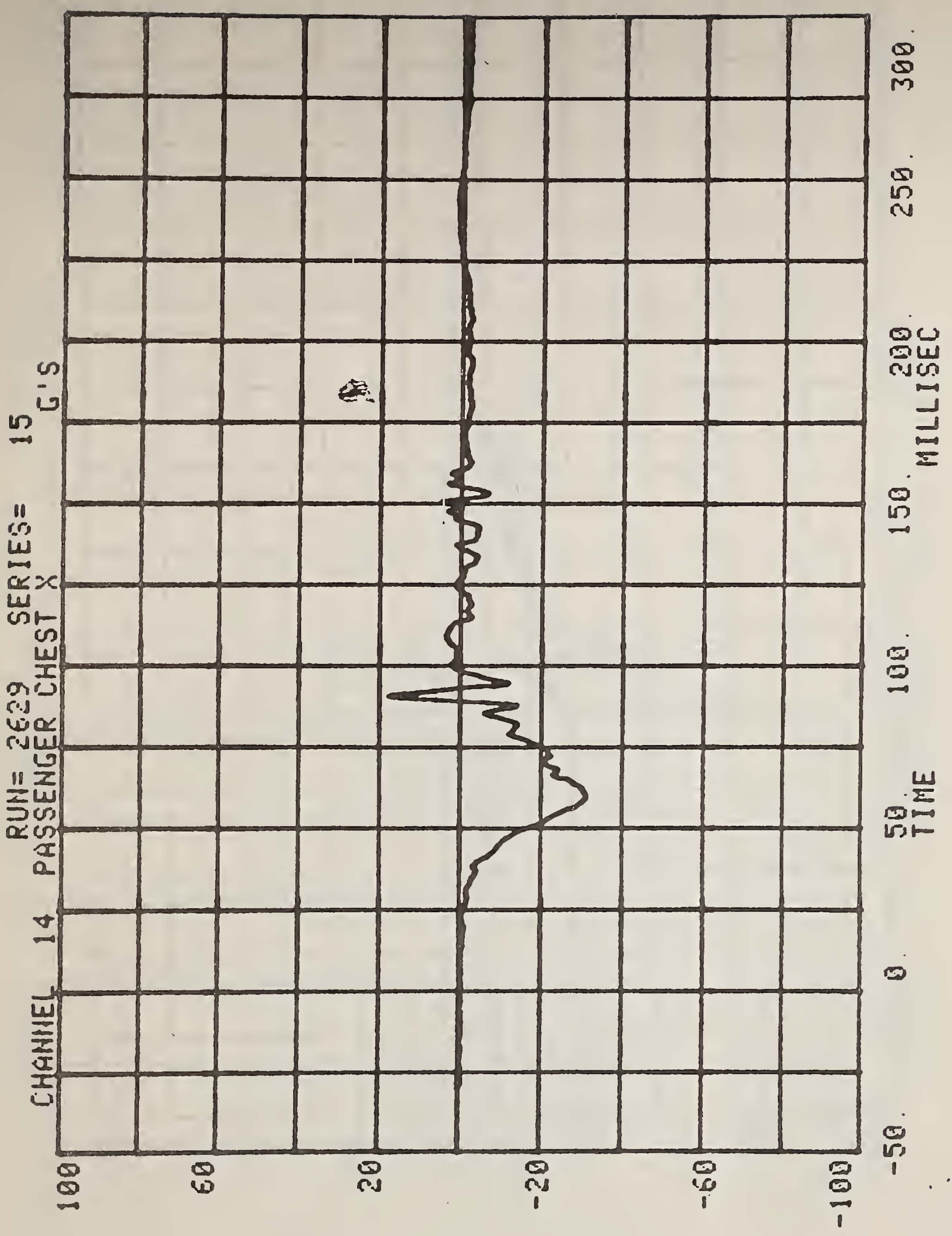

RUN= 2627 SERIES= 13
CHANNEL 11 PASSENGER HEAD X G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

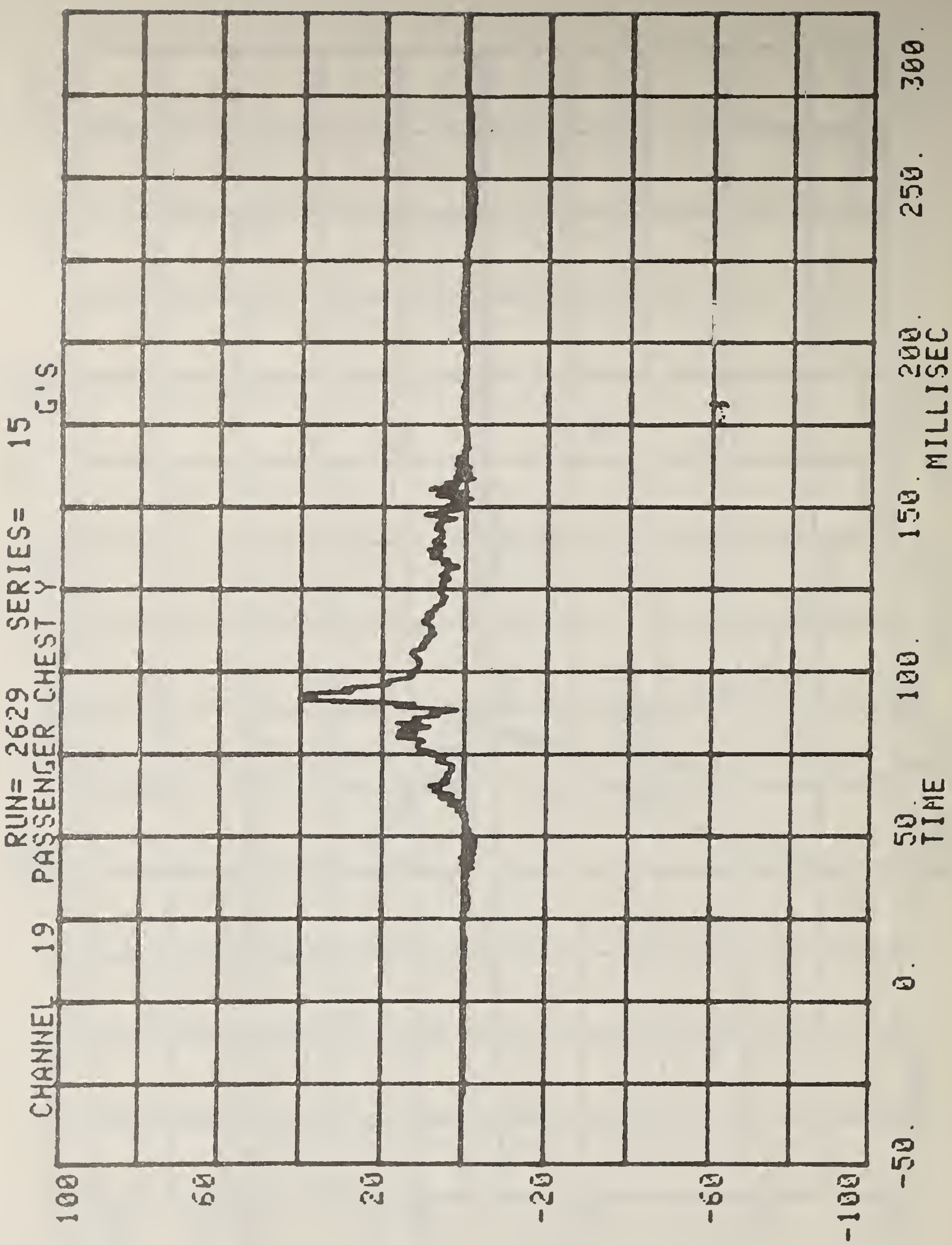

CHANNEL 12
RUN= 2629 SERIES= 15
PASSENGER HEAD Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

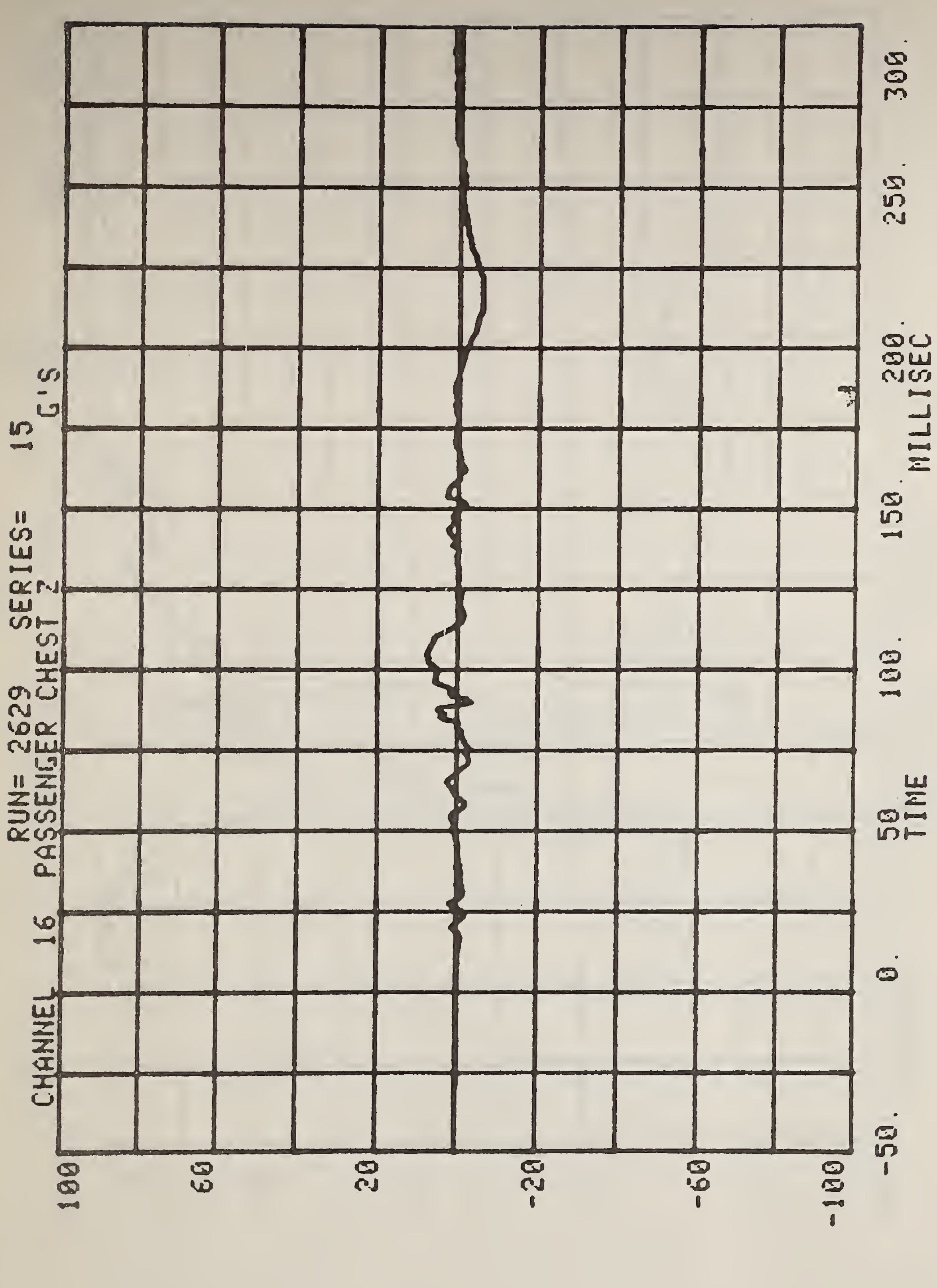


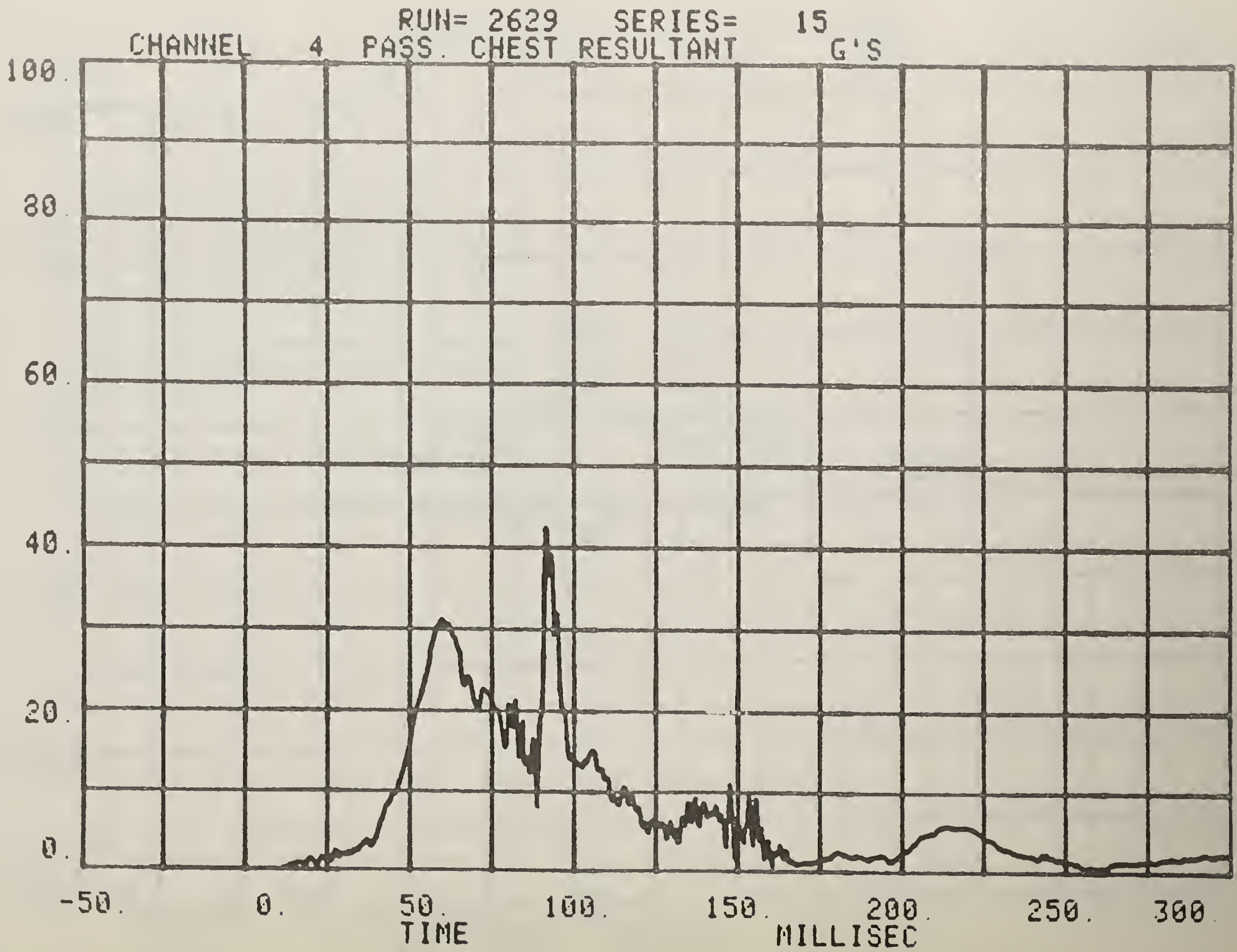
CHANNEL 13 RUN= 2629 SERIES= 15
PASSENGER HEAD Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

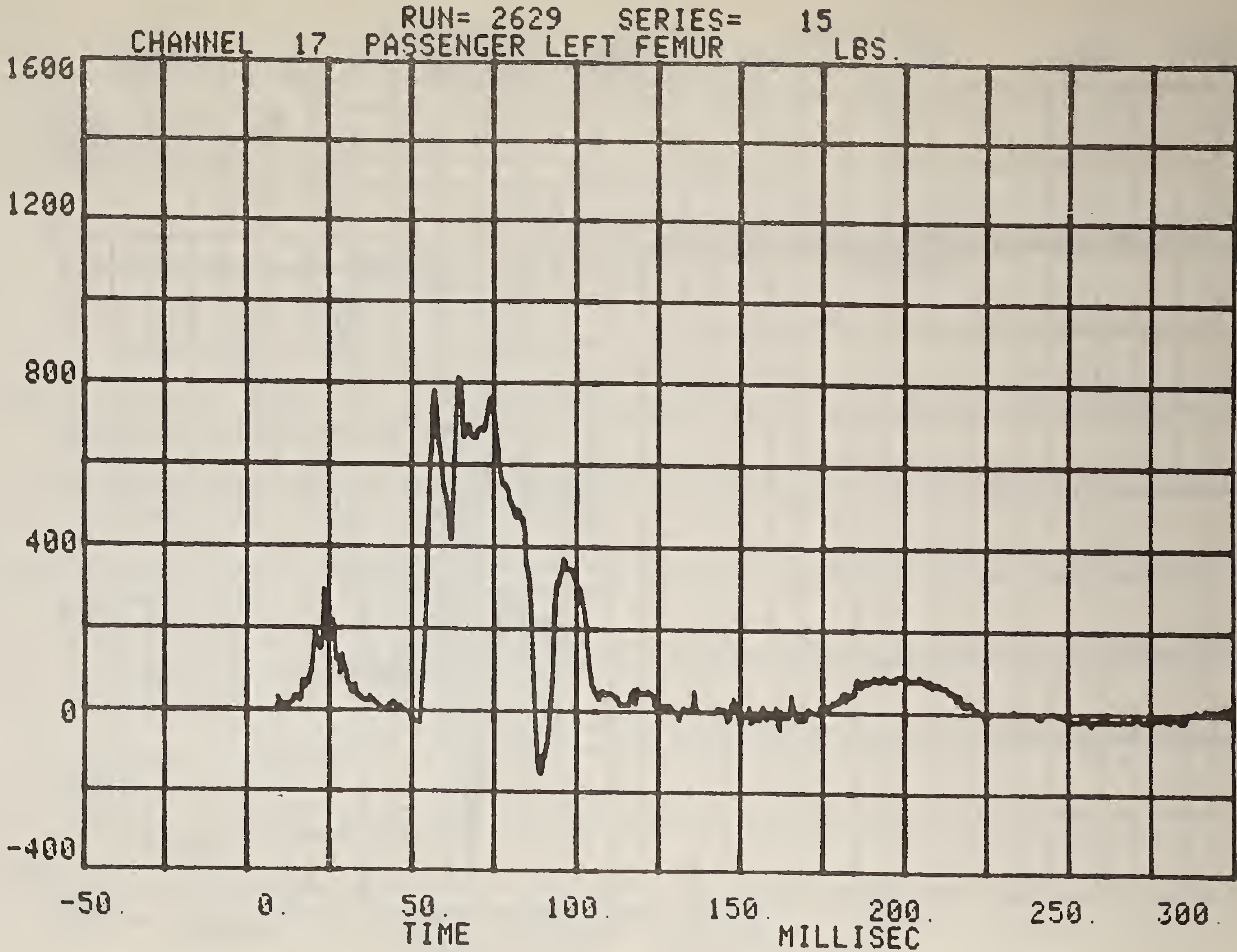

CHANNEL 3 RUN= 2629 SERIES= 15
PASS. HEAD RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC

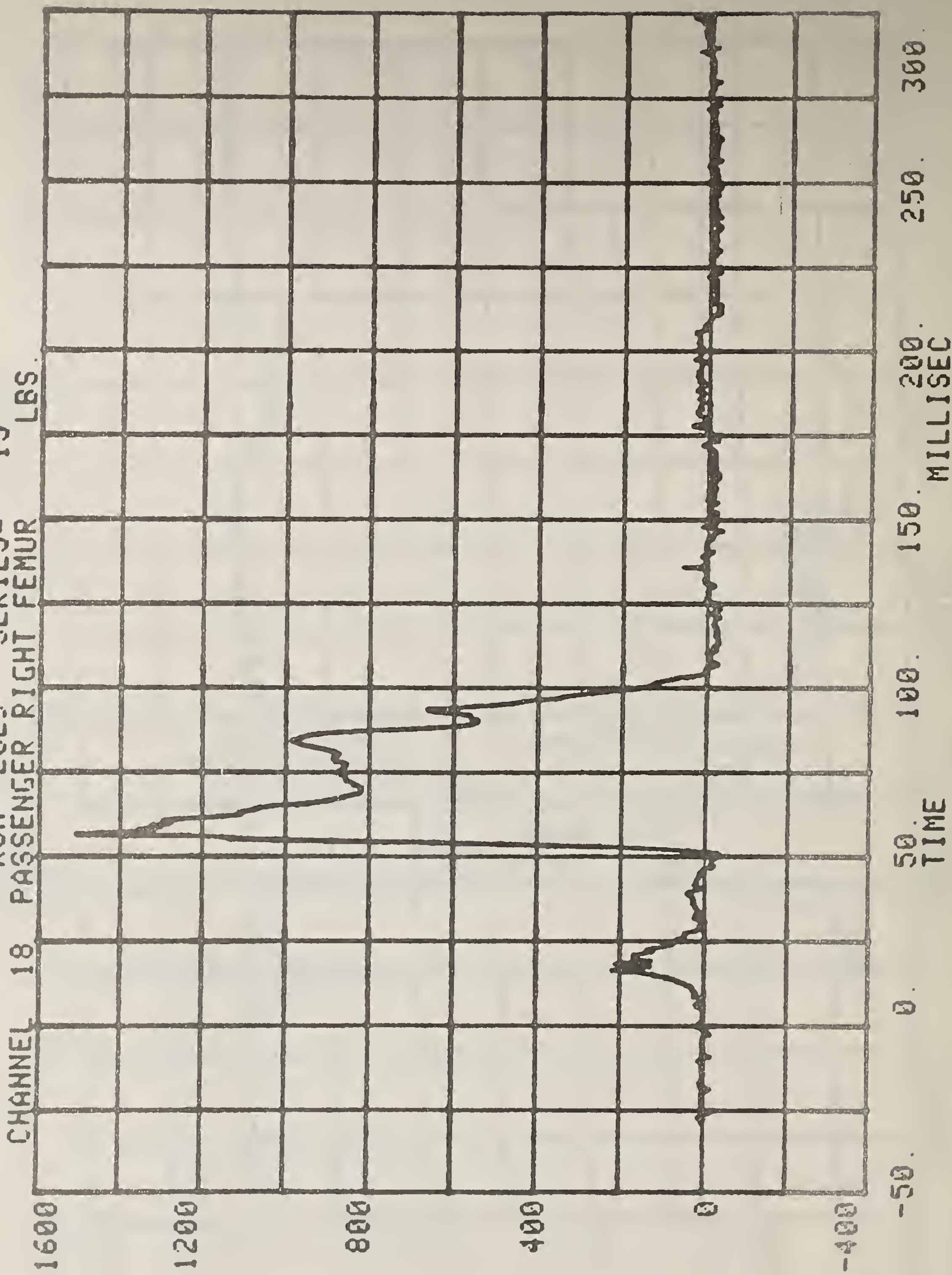

CHANNEL 14 RUN= 2629 SERIES= 15
PASSENGER CHEST X
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC

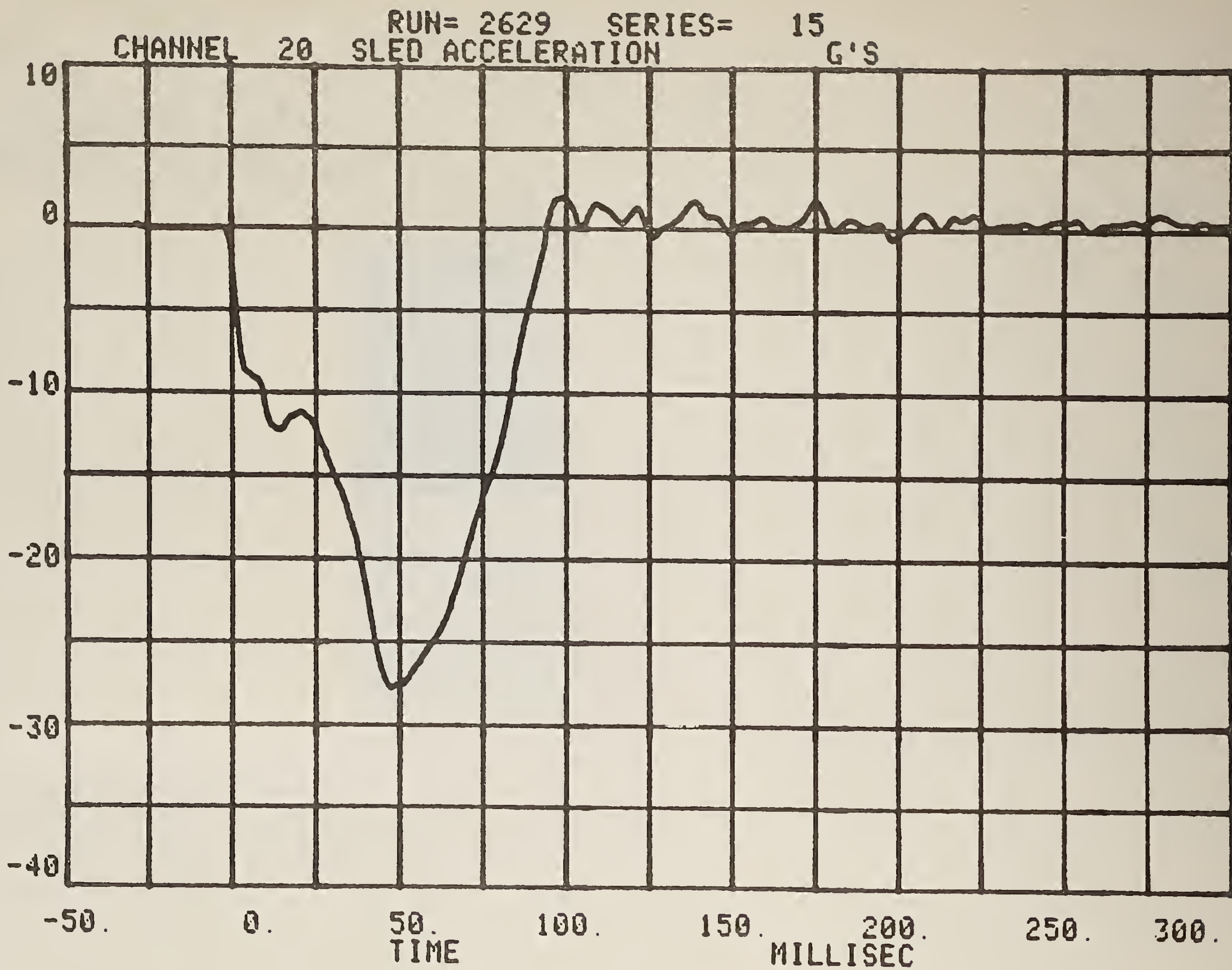

CHANNEL 19
RUN= 2629 SERIES= 15
PASSENGER CHEST Y
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 16 RUN= 2629 SERIES= 15
PASSENGER CHEST Z
G'S
100
60
20
-20
-60
-100
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2629 SERIES= 15
CHANNEL 4 PASS. CHEST RESULTANT G'S
100.
80.
60.
40.
20.
0.
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


RUN= 2629 SERIES= 15
CHANNEL 17 PASSENGER LEFT FEMUR LBS.
1600
1200
800
400
0
-400
-50.
0.
50.
100.
150.
200.
250.
300.
TIME
MILLISEC


CHANNEL 18 RUN= 2629 SERIES= 15
PASSENGER RIGHT FEMUR
LBS
1600
1200
800
400
0
-400
-50.
0
50.
100.
150.
200.
250.
300.
TIME
MILLISEC



CHANNEL 20 RUN= 2629 SERIES= 15
SLED ACCELERATION G'S
10
0
-10
-20
-30
-40
-50.
0.
50.
100.
150.
200.
250.
300.
TIME MILLISEC